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2. Subbasin Assessment-Water Quality Concerns and Water Quality Status

This section identifies the 13 water quality limited segments in the SF CWR Subbasin, the applicable WQS for these water bodies, existing water quality data, and data gaps. The SF CWR Subbasin, HUC 17060305, is comprised of the 82 water body units defined by Idaho Code (IDAPA 58.01.02.120.07) (see Table 1).

2.1 Water Quality Limited Segments Occurring in the SF CWR Subbasin

The water quality limited water bodies (DEQ 1999), beneficial uses, and pollutants are shown in Table 10. Figure 9 shows the water quality limited stream and river segments and their associated watersheds.

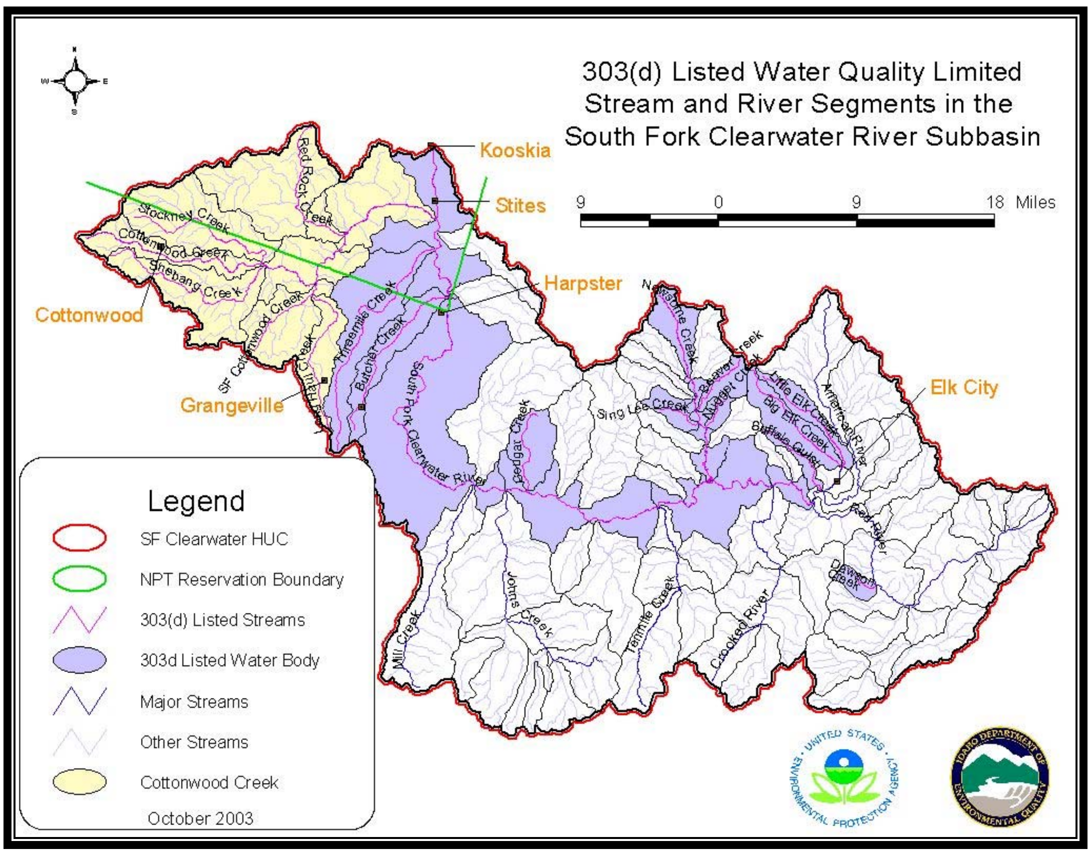

Figure 9. Water Quality Limited Water Bodies in the SF CWR Subbasin

The CWA requires the restoration and maintenance of the chemical, physical, and biological integrity of the nation's waters (33 USC §§ 1251 – 1387). States and qualified Tribes, pursuant to Section 318 of the CWA, are to adopt WQS necessary to protect fish, shellfish, and wildlife while providing recreation in and on water whenever attainable. Section 303(d) of the CWA establishes requirements for states and qualified Tribes to identify and prioritize water bodies that are water quality limited. States and qualified Tribes must publish a priority list of impaired waters every two years. For waters identified on this list, states and qualified Tribes must develop a TMDL set at a level to achieve WQS.

Table 10. Water quality limited water bodies in the SF CWR Subbasin.

Stream Name	Water Body ID(s)	Boundaries (1998 303(d) list)[a]	Beneficial Uses[b]	Stream Miles	Pollutant[c]
Threemile Creek	10	Headwaters to SF CWR	CW/SS(d) SCR(d)	49.8	Bac, DO, Qalt, Halt, NH_3, Nut, Sed, Temp
Butcher Creek	11	Headwaters to SF CWR	CW/SS(d) SCR(d)	18.9	Bac, DO, Qalt, Halt, Sed, Temp
Newsome Creek	62	Beaver Creek to SF CWR	CW/SS(e) PCR/SCR(e)	12.4	Sed
Lucas Lake	52		CW/SS(e) PCR/SCR(e)	.00	Sed
Beaver Creek	65	Headwaters to Newsome Creek	CW/SS(e) PCR/SCR(e)	6.7	Sed
Buffalo Gulch	59	Headwaters to American River	CW/SS(e) PCR/SCR(e)	6.5	Sed
Dawson Creek	38	Headwaters to Red River	CW/SS(e) PCR/SCR(e)	2.3	Sed
Nugget Creek	64	Headwaters to Newsome Creek	CW/SS(e) PCR/SCR(e)	4.6	Sed
Sing Lee Creek	73	Headwaters to Newsome Creek	CW/SS(e) PCR/SCR(e)	4.5	Sed
South Fork Clearwater River	1, 12, 22, 30, 36	Red River to Clearwater River	CW/SS(d) PCR(d) SRW (d)	248.8	Halt, Sed, Temp
Cougar Creek	79	Headwaters to SF CWR	CW/SS(e) PCR/SCR(e)	17.1	Sed
Little Elk Creek	57	Headwaters to Elk Creek	CW/SS(e) PCR/SCR(e)	12.7	Temp
Big Elk Creek	58	Headwaters to Elk Creek	CW/SS(e) PCR/SCR(e)	19.7	Temp

[a]Refers to a list created in 1998 of water bodies in Idaho that did not fully support at least one beneficial use. This list is required under section 303 subsection "d" of the Clean Water Act.
[b]CW = Cold Water, SS = Salmonid Spawning, PCR = Primary Contact Recreation, SCR = Secondary Contact Recreation, SWR= Special Resource Water
(d) = designated beneficial use, (e) = existing beneficial use
[c]Bac = bacteria, DO = dissolved oxygen, Qalt = flow alteration, Halt = habitat alteration, NH_3 = ammonia, Nut = nutrients, Sed = sediment, Temp = temperature

As a result of the court-ordered 303(d) listing by USEPA in 1994 (DEQ 1999), the entire main stem SF CWR and 49 tributaries were listed as water quality–limited, not including the

Cottonwood Creek drainage, which was addressed by a separate TMDL effort (DEQ, NPT, USEPA 2000). Streams were listed for numerous reasons, not only WQS violations. Nine streams came to the 303(d) list as a result of being identified in Appendix D of DEQ's 1992 305(b) report (DEQ 1992). The remaining 40 tributaries and the main stem SF CWR itself were listed because of information accumulated from the NPNF plan (USFS 1987), other NPNF studies, and Idaho's water quality status report (DEQ 1989).

Waters identified in Appendix D of the 1992 305(b) report were listed as potentially impaired sites needing further assessment to verify any actual WQS violations (including impaired beneficial uses) (DEQ 1989). Waters identified in USFS plan and other studies as not meeting forest plan objectives are not necessarily violating state WQS, as forest plan objectives may be quite different from state WQS. Idaho's Stream Segment of Concern (SSOC) listing process was a mechanism for the public to voice concerns about particular water bodies. Unfortunately, these lists likewise had little evidence of actual water quality problems or impaired uses. The SSOC waters were often identified as impaired simply because they were favored by the interested public. In all these cases, little actual data were available to assess whether or not these waters were violating WQS or impairing beneficial uses.

In 1998, DEQ attempted to rectify that situation by processing several years worth of Beneficial Use Reconnaissance Program (BURP) data in order to assess the status of beneficial uses and record WQS violations for these 303(d) listed streams. The 1998 DEQ 303(d) list (DEQ 1999) removed 39 of the original 49 tributaries listed under the court order. Section 3.2 discusses the analyses of the BURP data. The tributaries remaining on the 303(d) list are shown in Table 10. For waters within the Nez Perce Reservations, the 1994 303(d) list remains in effect.

2.2 Applicable Water Quality Standards

The water quality criteria (narrative and numeric) that are relevant for the designated and existing beneficial uses for the SF CWR Subbasin are discussed below. Designated beneficial uses listed for the main stem SF CWR include salmonid spawning, primary contact recreation, and special resource water (IDAPA 58.01.02). The beneficial uses of the 303(d) tributaries are listed above in Table 10. For undesignated 303(d) listed tributaries, the existing beneficial use for aquatic life in the SF CWR Subbasin is salmonid spawning and the existing beneficial use for recreation is primary or secondary contact recreation (IDAPA 58.01.02.101.01).

Beneficial Uses

Idaho WQS require that surface waters of the state be protected for beneficial uses, wherever attainable (IDAPA 58.01.02.050.02). These beneficial uses are interpreted as existing uses, designated uses, and "default" uses as briefly described in the following paragraphs. The *Water Body Assessment Guidance*, second edition (Grafe et al. 2002) gives a more detailed description of beneficial use identification for use assessment purposes.

Existing Uses

Existing uses under the CWA are "those uses actually attained in the water body on or after November 28, 1975, whether or not they are included in the water quality standards." The existing beneficial uses and the level of water quality necessary to protect the uses shall be maintained and protected (IDAPA 58.01.02.003.35, .050.02, and 051.01 and .053). Existing uses include uses which have occurred since 1975, whether or not the level of water quality to fully support the uses exists.

Designated Uses

Designated uses under the CWA are "those uses specified in WQS for each water body or segment, whether or not they are being attained." Designated uses are simply uses officially recognized by the state. In Idaho these include things like aquatic life support, recreation in and on the water, domestic water supply, and agricultural use. Water quality must be sufficiently maintained to meet the most sensitive use. Designated uses may be added or removed using specific procedures provided for in state law, but the effect must not be to preclude protection of an existing higher quality use such as cold water aquatic life or salmonid spawning. Designated uses are specifically listed for water bodies in Idaho in tables in the Idaho WQS (see IDAPA 58.01.02.003.22 and .100, and IDAPA 58.01.02.109-160).

Presumed Uses

In Idaho, most water bodies listed in the tables of designated uses in the WQS do not yet have specific use designations. Until such time as specific uses are designated, and absent information on existing uses, DEQ presumes that most waters in the state will support cold water aquatic life and either primary or secondary contact recreation (IDAPA 58.01.02.101.01). To protect these so-called "presumed uses," Idaho WQS indicate that the numeric criteria for cold water aquatic life and primary or secondary contact recreation criteria will be applied to undesignated waters. If other more restrictive existing use occur in the water body (e.g., salmonid spawning), then the criteria for those uses would apply as well (e.g., intergravel dissolved oxygen, temperature). However, if for example, cold water aquatic life is not found to be an existing use, a use designation to that effect is needed before some other aquatic life criteria (such as seasonal cold) can be applied in lieu of cold water criteria (IDAPA 58.01.02.101.01).

Water Quality Criteria

Details of Idaho WQS may be seen in the state of Idaho Web site (www2.state.id.us/adm/adminrules/rules/IDAPD581/0102.pdf) or obtained from DEQ's Lewiston Regional Office. Idaho WQS include criteria necessary to protect designated beneficial uses. The standards are divided into three sections: General Surface Water Criteria, Surface Water Quality Criteria for Use Designations, and Site-Specific Surface Water Quality Criteria (IDAPA 58.01.02). The numeric standards that exist in these rules for *Escherichia coli* (*E. coli)* bacteria, temperature, turbidity, ammonia, and dissolved oxygen will be used in the TMDL. The standards for nutrients and sediment are narrative standards. A narrative standard states that the level of a pollutant cannot exceed quantities above natural background that impair beneficial uses. Because these pollutants do not have numeric standards, surrogate numeric targets are proposed in the TMDL (Sections 5.2 and 5.3). According to IDAPA 58.01.02.070.07, numeric WQS are to apply to intermittent waters during optimum flow periods sufficient to support the uses for which the water body is designated. Optimum flows are defined as 5.0 cfs for recreation and water supply uses and 1.0 cfs for aquatic life uses.

These WQS pertain to those times and locations where stream flow is non-intermittent. Idaho rule (IDAPA 58.01.02.003.50) defines an intermittent stream as "A stream which has a period of zero flow for at least one week during most years. Where flow records are available, a stream with a 7Q2 (seven day, 2 year low flow) hydrologic-based design flow of less than one-tenth (0.1) cfs is considered intermittent. Streams with perennial pools which create significant aquatic life uses are not intermittent." Stream segments of zero flow occur between perennial pools within portions of the Threemile Creek and Butcher Creek watersheds.

Idaho WQS pertaining to point source discharges stipulate "the width of the mixing zone is not to exceed more than twenty five percent (25%) of the stream width, and more than twenty five percent (25%) of the volume of the stream flow" (IDAPA 58.01.02.060.01).

Also, in the case of permitted point source discharges, additional stipulations for the mixing of wastewater discharge may be applied. For example, unless specific exemptions are made, "the temperature of the wastewater must not affect the receiving water outside the mixing zone so that: (i) the temperature of the receiving water or of downstream waters will interfere with designated beneficial uses, (ii) daily and seasonal temperature cycle characteristics of the water body are not maintained, … (iv) if the water is designated for cold water aquatic life or salmonid spawning, the induced variation is more than plus one (+1) degrees C" (IDAPA 58.01.02.401.03.a). The wastewater may not increase turbidity of receiving water outside the mixing zone by more than 5 nephlometric turbidity units (NTU) over background, when background turbidity is 50 NTU or less, or by more than 10% when background is more than 50 NTU, not to exceed a maximum increase of 25 NTU (IDAPA 58.01.02.401.03.b). These and other considerations specific to the WWTP point source discharge will be determined by the local DEQ permitting engineer during 401 permit certification.

A subset of the Idaho WQS as defined in Idaho Code 58.01.02 that pertains to the SF CWR Subbasin follows below. All surface water quality criteria are subject to the clause, "Surface waters are not to vary from the following characteristics due to human activities.".

Temperature Idaho State Standard for Cold Water Aquatic Life: Water temperatures of twenty-two(22) degrees C (71.6 ^{o}F)or less with a maximum daily average of no greater than nineteen (19) degrees C (66.2 ^{o}F) (IDAPA 58.01.02.250.02b).

Idaho State Standard for Salmonid Spawning: Water temperatures of thirteen (13) degrees C (55.4 ^{o}F)or less with a maximum daily average no greater than nine (9) degrees C (48.2 ^{o}F) (IDAPA 58.01.02.250.02e). (See Appendix D for SF CWR fish varieties spawning intervals.)

Federal Bull Trout Standard: 10^{o}C (50 ^{o}F)expressed as an average of daily maximum temperatures over a seven-day period, referred to as the "mean weekly maximum temperature (MWMT). Applies during months of June, July, August, and September to water bodies identified in Appendix B of the July 1997 Federal Register.

Sediment Idaho State Standard for Sediment: Sediment shall not exceed quantities specified in Sections 250 and 252, or in the absence of specific sediment criteria, quantities which impair designated beneficial uses. Determinations of impairment shall be based on water quality monitoring and surveillance and the information utilized as described in Section 350 (IDAPA 58.01.02.200.08).

Turbidity standard for Cold Water Aquatic Life: Turbidity below any applicable mixing zone set by the Department, shall not exceed background turbidity by more than fifty (50) NTU instantaneously or more than twenty-five (25) NTU for more than ten (10) consecutive days (IDAPA 58.01.02.250.02d).

Nutrients Idaho State Standard for Excess Nutrients: Surface waters shall be free from excess nutrients that can cause visible slime growth or other nuisance aquatic growths impairing designated beneficial uses (IDAPA 58.01.02.200.06).

Pathogens Idaho State Standard for Primary and Secondary Contact Recreation. Primary Contact Recreation: Waters designated for primary contact recreation are not to contain *E. coli* bacteria significant to public health in concentrations exceeding:

a. A single sample of four hundred six (406) *E. coli* organisms per one hundred (100) ml; or

b. A geometric mean of one hundred twenty-six (126) *E. coli* organisms per one hundred (100) ml based on a minimum of five (5) samples taken every three (3) to five (5) days over a thirty (30) day period (IDAPA 58.01.02.251.01).

Secondary Contact Recreation: Waters designated for secondary contact recreation are not to contain *E. coli* bacteria significant to public health in concentrations exceeding:

a. A single sample of five hundred seventy-six (576) *E. coli* organisms per one hundred (100) ml; or

b. A geometric mean of one hundred twenty-six (126) *E. coli* organisms per one hundred (100) based on a minimum of five (5) samples taken every three (3) to five (5) days over a thirty (30) day period (IDAPA 58.01.02.251.02).

Ammonia — Idaho State Standard for Cold Water Aquatic Life and Salmonid Spawning As defined in tables in 58,01.02.250.02.c.i. and ii.; pH dependent.

Dissolved Oxygen — Idaho State Standard for Cold Water Aquatic Life:

Waters designated for cold water aquatic life are not to vary from the following characteristics due to human activities:
a. Dissolved oxygen concentrations exceeding 6 mg/L at all times.

Idaho State Standard for Salmonid Spawning:
(1) Intergravel dissolved oxygen
(a) One (1) day minimum of not less than five point zero (5.0) mg/L.
(b) Seven day average mean of not less than six point zero (6.0) mg/L.

(2) Water Column dissolved oxygen
(a) One (1) day minimum of not less than six point zero (6.0) mg/L or ninety percent (90%) of saturation, whichever is greater (IDAPA 58.01.02.250.02).

2.3 Summary and Analysis of Existing Water Quality Data

Table 12 displays sources of existing water quality and stream habitat data obtained from local agencies used in the development of the temperature and sediment TMDLs.

Subbasin-wide Biological and Other Data

The stream habitat data, reference stream data, and fish data assembled for this analysis is discussed below. Sources for the data are shown in Table 11.

Stream Habitat Data

The BLM (Johnson 1999) completed the *Biological Assessment of the Lower South Fork Clearwater River and Tributaries* as part of its biological assessment of ongoing and proposed BLM activities on Endangered Species Act (ESA) listed salmonids. The main stem SF CWR below the NPNF, and tributaries including Threemile Creek, Butcher Creek, Mill Creek, and Sally Ann Creek, were assessed using the *Matrix of Pathways and Indicators of Watershed Condition - Local Adaptation for the Clearwater Basin* (NMFS et al. 1998). For most of the criteria evaluated, conditions in the lower SF CWR and tributaries were suboptimal, rating "low" for habitat condition.

Table 11. Sources of water quality data.

Data Type[a]	Source[b]	Location
Stream Habitat Data	Lower SF CWR and tributaries Biological Assessment SF CWR Biological Assessment	BLM NPNF
Reference Stream Data	NPNF Wallowa-Whitman National Forest	Appendix N Appendix N
Fisheries Resources Report	Fish TAG Report	Appendix D
Fish TAG Report	SF CWR Fish TAG	Appendix D
BURP Data	DEQ	Appendix K
Flow Data	1995 Earthinfo compact disc USGS (Boise office) USEPA Storet database Clearwater Subbasin summary, NWPP Council (2001)	Section 2.3.2
Temperature Data	NPNF, NPT, BLM, IDFG, and DEQ thermographs Thermal Infrared Imaging	Appendix J DEQ Report (2001)
Sediment Data: TSS and Bedload Sediment Loading Calculations Stream Erosion Inventory Sediment Budget	 NPNF, NPT and DEQ TMDL DEQ, NPT, USEPA (TMDL) TMDL	 Appendix M Chapter 5 Appendix L Appendix L

[a]Fish TAG = fisheries technical advisory group, BURP = Beneficial Use Reconnaissance Program, TSS = total suspended solids
[b]NPNF – Nez Perce National Forest, DEQ = Department of Environmental Quality, USGS = U.S. Geological Survey, USEPA = U.S. Environmental Protection Agency, NWPP = Northwest Power Planning Council , NPT = Nez Perce Tribe, BLM = Bureau of Land Management, IDFG = Idaho Department of Fish and Game

The *South Fork Clearwater River Biological Assessment* (USFS 1999) rates the biological condition of 15 major watersheds in the SF CWR Subbasin for ESA listed species using the *Matrix of Pathways and Indicators of Watershed Condition - Local Adaptation for the Clearwater Basin* (NMFS et al. 1998). The watersheds assessed include the Red River, American River, Crooked River, Newsome Creek, Leggett Creek, Tenmile Creek, Twentymile Creek, Wing Creek, Silver Creek, Peasley Creek, Cougar Creek, Johns Creek, Meadow Creek, Mill Creek, and the SF CWR main stem and face drainages. Summarized at a watershed scale, the majority of water quality and habitat elements rate as "low" condition, while watershed condition (road parameters), channel conditions, and species take (harassment, redd disturbance, juvenile harvest) rate as "moderate" condition. Appendix K contains the Environmental Baseline/Habitat Condition rating. Water quality and stream habitat results for the 303(d) listed segments are discussed in Chapter 1, Stream Characteristics.

Reference Stream Habitat Data

To better assess the condition of streams and rivers of the SF CWR Subbasin as they are affected by sediment, we acquired two data sets for hydrologic systems considered to be in good to near pristine condition. We acquired data sets that consisted of measures of cobble embeddedness, percent pools, residual pool volumes, pool filling, bank full width, and Rosgen channel type. Stream habitat data were acquired from the NPNF for Meadow Creek in the Selway basin and Bargamin Creek that drains into the Salmon River. These two systems lie immediately to the east of the SF CWR Subbasin, are largely unroaded or otherwise disturbed, have similar geology and geomorphology to the forested streams of the upper SF CWR, and have reasonable data sets because they are recognized by the NPNF as being systems in good condition that can be used as reference. As a reference for the lower SF CWR main stem, particularly within the basalts, we acquired data from the Wallowa-Whitman National Forest for the Imnaha River above the Forest Service boundary. The Imnaha River lies about 50 miles to the west of the SF CWR Subbasin in Oregon. It flows down out of the Eagle Cap Wilderness through some relatively undisturbed basalt forest lands into the Snake River.

To compare these reference data to streams and rivers in the SF CWR Subbasin, we acquired two different data sets for the subbasin. We acquired the set of stream habitat data from the NPNF, which covered portions of the upper basin streams. We also contracted with a private company to collect these same data for the main stem SF CWR. The reference data are presented in Appendix N.

Fish Data

Pertinent fish data including IDFG snorkeling surveys conducted for the SF CWR main stem in 2000, historic influences on fisheries resources, and current status of salmonid populations in the subbasin are discussed in Appendix D, Fisheries Resources. Tables 12 and 13 list species known to be present in the SF CWR Subbasin.

A Fish TAG was convened to provide professional judgement regarding the status of local fish populations, the habitat quality in the subbasin, and the effects of nonpoint source pollutants. The group was comprised of fish biologists and hydrologists from the National Marine Fisheries Service (NMFS), NPT, NPNF, IDFG, USEPA, and BLM. In order to prioritize restoration needs for fisheries in the subbasin, the group ranked the quality of the 82 water bodies for each species.

Water bodies were ranked for current fish population presence, current condition of habitat, natural inherent water body potential, pollutant severity, and conservation/preservation priority. Areas ranked "conserve" are areas currently considered to be of high habitat quality. Appendix D shows the Fish TAG water body ranking chart and maps illustrating current habitat condition by species, water body potential by species, and restoration potential.

Table 12. Salmon, trout, and char species present in the SF CWR Subbasin.

Common Name	Scientific Name
Bull trout	*Salvelinus confluentus*
Spring chinook salmon	*Oncorhynchus tschawytscha*
Snake River fall chinook	*Oncorhynchus tschawytscha*
Steelhead rainbow /redband trout	*Oncorhynchus mykiss*
Westslope cutthroat trout	*Oncorhynchus clarki lewisi*
Brook trout (introduced species)	*Salvelinus fontinalis*

Table 13. Other fish species known to occur in the SF CWR Subbasin.

Common Name	Scientific Name	Origin
Pacific lamprey	*Lampetra tridentatus*	Native
Mountain whitefish	*Prosopium williamsoni*	Native
Northern pikeminnow	*Ptychocheilus oregonensis*	Native
Chiselmouth	*Acrocheilus alutaceus*	Native
Bridgelip sucker	*Catostomus columbianus*	Native
Sculpin	*Cottus sp.*	Native
Black bullhead	*Ictalurus melas*	Introduced
Redside shiner	*Richardsonius balteatus*	Native
Speckled dace	*Rhinichthys osculus*	Native
Longnose dace	*Rhinichthys cataractae*	Native
Smallmouth bass	*Micropterus dolomieui*	Introduced

BURP Data and WBAG Assessment

IDAPA 58.01.02.053 establishes a procedure to determine whether a water body fully supports designated and existing beneficial uses. The procedure detailed in the *1996 Water Body Assessment Guidance* (WBAG) (DEQ 1996a) and revised in 2002 (Grafe et al. 2002) relies on physical, chemical, and biological parameters to identify water quality limited segments that require TMDL development.

The General Surface Water Quality Criteria (IDAPA 58.01.02.200) for Idaho set forth general guidance for surface water quality. The Surface Water Quality Criteria for Aquatic Life Use Designations (IDAPA 58.01.02.250) set forth specific numeric criteria to be met for particular beneficial uses. It also sets forth "narrative" standards that require a logical accumulation of evidence to determine whether a water body is supporting its beneficial uses. The WBAG sets forth a methodology whereby a water body is first assessed using the numeric criteria for a particular beneficial use, then identifies indices and methods for "narrative" assessment of pollutants for which numeric criteria do not apply or are not available (DEQ 1996a; Grafe et al. 2002). Sediment is the primary pollutant addressed by narrative means in the WBAG.

Idaho determines if its narrative sediment criteria are being met by collecting BURP data to verify if viable communities of aquatic organisms are present and if evidence of beneficial use exists in the stream. The BURP is a consistent scientific process used statewide for collecting this data. The evaluatation of the BURP data using WBAG results in indices used to compare water quality with the standards to determine beneficial use support status. Figure 10 shows all of the BURP locations in the SF CWR Subbasin.

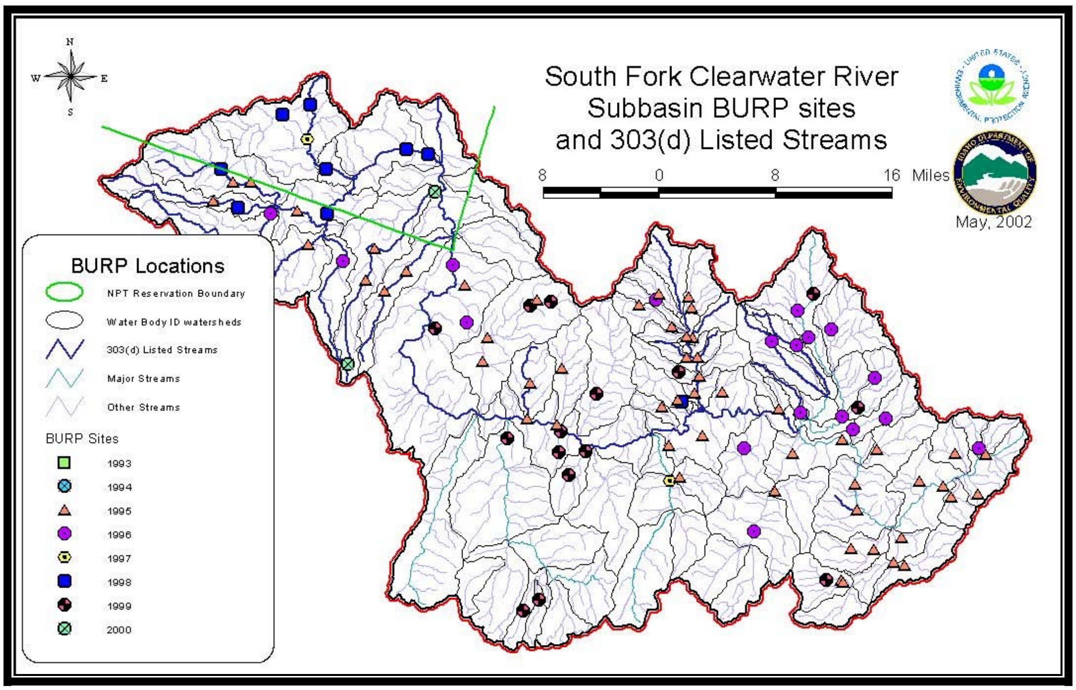

Figure 10. Locations of BURP Sites Throughout the SF CWR Subbasin

BURP surveys were completed on the 303(d) streams in the SF CWR Subbasin during the summer monitoring seasons of 1995, 1996, and 2000. The BURP surveys collected data on fish, macroinvertebrates, and stream habitat. The data were analyzed through a systematized and statistical process to determine whether a particular water body supports its beneficial uses as described in the WBAG. The WBAG results using the 1996 version for the 303(d) listed water bodies are presented in Table 14. Several streams have two BURP sites; and therefore, two sets of results. These are the WBAG results that were used in the development of the 1998 303(d) list (DEQ 1999). Table 15 presents the results of analyzing the same data for the 303(d) listed water bodies using the 2002 version of WBAG.

Table 14. WBAG version 1996 results for 303(d) listed water bodies in the SF CWR Subbasin.

Water Body	Macro-invertebrate Biotic Index (MBI)	Salmonid Age Classes[a]	Temper-ature (^{0}C)	Habitat Index (HI)	Support Status[b]
Threemile Creek (L)[c]	3.30	1	16	104	NFS
Threemile Creek (U)[d]	2.61	0	15	75	NFS
Butcher Creek (L)	3.04	1	23	85	NFS
Butcher Creek (U)	3.42	0	18	85	NV
Newsome Creek (L)	3.79	5+j	19	104	NFS
Newsome Creek (U)	3.71	5?	16	89	NV
Beaver Creek	2.18	3+j	13	104	NFS
Buffalo Gulch	2.93	1+j	9	98	NFS
Dawson Creek	4.13	1	9	99	NFS
Nugget Creek	4.23	1	11	106	NFS
Sing Lee Creek	3.22	2	15	141	NFS
SF Clearwater	*e	*	*	*	*
Cougar Creek (L)	4.12	0	13	101	NFS
Cougar Creek (U)	3.61	Fish barrier ½ mi below BURP[f] reach	12	99	FS

[a]+j = including juveniles
[b]FS = Full support, NFS = Not full support, NV = Needs verification, from 1998 303(d) list (DEQ 1999)
[c]L = Lower
[d]U = Upper
[e]To be assessed using the Large River Protocol, which is not yet available
[f]Beneficial Use Reconnaissance Program

Within the 1996 WBAG protocol, the macroinvertebrate biotic index (MBI) is the primary indices used to confirm beneficial uses support status. The MBI score is generated from seven different qualities about macroinvertebrates (aquatic insects). Examples of the qualities include diversity of species, richness of species diversity, species guilds, and pollutant tolerance of insects present. An MBI score of 3.5 or more indicates that the macroinvertebrate community is not impaired, a score between 2.5 and 3.5 indicates that more information is needed, and a score of 2.5 or less indicates that the macroinvertebrate community is impaired. Newsome Creek, Dawson Creek, Nugget Creek, and Cougar Creek MBI scores indicate that these water bodies are supporting their beneficial uses.

The second indicator of full supprt of beneficial uses is the presence of salmonid species and their young of the year in a stream. If three age classes of fish, including juveniles (fish <100 mm in length) are present, then a water body is considered to be fully supporting salmonid spawning. If only two age classes including juveniles are present, then the habitat index (HI) is considered. The HI utilizes both quantitative and qualitative stream data to determine the level of habitat impairment within three ranges as compared to the ecoregion reference condition. If the HI is 73 or greater, the water body is considered to be fully supporting its beneficial uses. Less than two age classes of salmonids, including juveniles, indicates that the water body is not fully supporting its beneficial uses. If no fish length data or no fish data exist at all, then salmonid spawning beneficial use is not assessed (DEQ 1996a). The HI scores and presence of salmonids in Beaver Creek and Sing Lee indicate that these water bodies are supporting their beneficial uses.

Following a literal interpretation of the WBAG 1996 version, only Threemile Creek and Butcher Creek data are not fully supporting their beneficial uses, with Buffalo Gulch needing verification. The reasoning for maintaining the other water bodies on the 1998 303(d) list is unknown at this time.

Table 15. WBAG version 2002 assessment of the 303(d) listed wadeable streams in the SF CWR Subbasin.

Water Body	SMI	SHI	SFI	WB Score
Threemile	MS	MS	MS	1.6
Butcher	1.0	1.0	MS	1.0
Dawson	2.0	2.0	2.0	2.0
Buffalo Gulch	2.0	3.0	3.0	2.7
Newsome	3.0	3.0	ND	3.0
Nuggett	3.0	3.0	3.0	3.0
Beaver	1.0	3.0	3.0	2.3
Sing Lee	1.0	3.0	ND	2.0
Cougar	2.0	3.0	ND	2.5

SMI = Stream Macrobiotic Index; SHI = Stream Habitat Index; SFI = Stream Fish Index; MS = Multiple Sites; ND = No Data.

In the WBAG version 2002, a Water Body Score of 2 or greater is passing. All of the water bodies except Threemile Creek and Butcher Creek in the SF CWR have scores of 2 or greater. Note that Sing Lee Creek, Cougar Creek, Beaver Creek, Dawson Creek, and Buffalo Gulch, though passing, have the lowest scores.

These WBAG assessment results of the 303(d) listed water bodies above Harpster indicate that sediment may not be significantly impairing water quality in the upper basin water bodies. However, in the context of the narrative sediment WQS, we need to look at other data types and reach a conclusion based on all of them. Using WBAG version 2002, these BURP data by themselves cannot be used to make the status call because they are more than 5 years old and were collected using somewhat different methods. Also, WBAG version 2002 requires consideration of qualified non-BURP data, which is not shown in Table 15.

For all the other BURP sites in the SF CWR Subbasin shown in Figure 10, assessments using either the WBAG version 1996 or version 2002 indicate full support of beneficial uses.

Subbasin Flow Characteristics

The following gauging station data were obtained from a variety of sources including a 1995 Earthinfo® compact disc, the USGS, and a 1998 USEPA Storet compact disc (Table 16). There are a number of active gauging stations in the subbasin, perhaps more than the typical subbasin (Table 16). The USGS maintains an active gage on the SF CWR at Stites (#13338500). Flow data have been collected here since 1964. The USGS also collects water quality trend monitoring data at this site. The USGS has had two other gages on the SF CWR in the past, one near Elk City (#13337500) at the confluence of the American and Red Rivers (1944 to 1974), and one near Grangeville (#13338000, 1910 to 1963). The Grangeville station was moved to Stites just prior to the removal of a dam that existed on the SF CWR near the NPNF boundary. The NPNF has four active gauging stations in the subbasin that have operated since 1986; on Red River, South Fork Red River, Trapper Creek, and Johns Creek. Summary statistics are provided for the SF CWR stations in Tables 17-19.

Additionally, there were several stations across the basin that operated for very short periods of time. Two stations established and operated in the late 1980s on Crooked River, one near Orogrande (#13337510) and the other near the river mouth near Elk City (#13337520). Station #13337200, at Red Horse Creek near Elk City, collected a few discharge measurements in the late 1970s, as did stations on Leggett Creek near Golden (#13337540), Peasley Creek near Golden (#13337700), and Sally Ann Creek near Stites (#13338200). These data are of limited value due to their small amount.

USGS Station Information

Station #13338500 SF CWR at Stites
Drainage area = 1,150 square miles

- Elevation = 1,311 feet
- Latitude and Longitude = 46°05'12" 115°58'32"
- Location = NE1/4 SE1/4 NE1/4 sec.29 T32N R4E, Idaho County, on left bank 0.4 mile upstream from county road bridge, 0.4 mile downstream from Cottonwood Creek, at river mile 4.0.
- Extremes of Record = Maximum discharge 12,100 cfs, gage height 8.82 feet, on February 7, 1996; minimum discharge 48 cfs, gage height 2.39 feet, on November 30, 1987.
- Period of Record = October 1910 – April 1912, October 1964 - present.
- Extremes Outside of Record = 17,500 cfs, gage height 10.3 feet, on June 8, 1964.

Station #13337500 SF CWR near Elk City

- Drainage area = 261 square miles
- Elevation = 3,816 feet
- Latitude and Longitude = 45°49'29" 115°31'36"
- Period of Record = 1945 - 1974

Station #13338000 SF CWR near Grangeville

- Drainage area = 865 square miles
- Elevation (Datum) = 1,830 feet
- Latitude and Longitude = 45°54'49" 116°00'17"
- Period of Record = 1911 – 1963, 2000 -- present

Station #13342450 Lapwai Creek near Lapwai

- Drainage Area = 235 square miles
- Elevation = 865 feet
- Latitude and Longitude = 46°25'36"'116 °48'15"
- Period of Record = 1974 – present

The SF CWR has a snowmelt runoff dominated flow pattern. Highest mean monthly flows occur in spring (April-June) and lowest flows occur in the fall and winter. It is likely that April high flows are predominantly prairie and other lower elevation snowmelt runoff events, whereas June high flows are predominantly high country snowmelt runoff. An average spring runoff peak at Stites is about 5,000 to 7,000 cfs. The annual runoff from the subbasin as measured at Stites averages about 12 inches. The largest flood had an estimated peak of 17,500 cfs. Floods occasionally result from snowmelt or rain-on-snow events between November and March.

The major tributary streams in the upper forested region (American, Red, and Crooked Rivers, and Newsome Creek) have runoff regimes very similar to the SF CWR (USFS 1999). These streams typically do not have a flashy response to storms. Their moderately rolling topography, relatively deep soils, forest vegetation, and cooler climate ameliorate rapid runoff. Further down the drainage below Newsome Creek to the NPNF boundary the tributary runoff regimes become more complex. High elevations in Johns and Tenmile Creeks create later runoff peaks and cooler water inputs into the SF CWR later in the summer (USFS 1999). Smaller tributaries in the canyon breaklands can be more flashy in response to rain-on-snow events and thunderstorms that create localized flooding and debris torrents. Tributaries on the prairie have very different runoff patterns than those in the forested region. Peak flows can occur in mid-winter in addition to spring peaks due to rain-on-snow and/or rapid snowmelt (USFS 1999). Low flows are reached earlier in the season and last longer through the year than up-river tributaries.

Because the TMDLs developed in this document are heavily dependent on understanding the flows in Threemile and Butcher Creeks, as well as Cottonwood Creek, we have estimated flow patterns in these drainages based on flow data from Lapwai Creek. Lapwai Creek drains the Camas prairie, at the same elevations as Threemile and Butcher Creeks, and has many of the same vegetative, geologic, landform, and land use characteristics. We constructed stochastic flow regimes for Threemile and Butcher Creeks based on the flow patterns from Lapwai Creek following roughly the same procedure used in the Cottonwood Creek TMDL (DEQ, NPT, USEPA 2000).

Table 16. USGS and Storet Stations in the SF CWR Subbasin.

Station #	Location	Parameters	Source[a]	Time Period
13337500	SF CWR near Elk City	Discharge, monthly and annual means	Earthinfo	1911-1963 2000-present
13337510	Crooked River near Orogrande	Discharge, water temperature	USGS, Boise	1986-1989
13337520	Crooked River near mouth	Discharge, water temperature	USGS, Boise	1984-1988
13338000	SF CWR near Grangeville	Discharge, monthly and annual means	Earthinfo	1914-1963
13338500	SF CWR at Stites	Discharge, monthly and annual means, peaks	USGS, Web site	1965-present
13338500	SF CWR at Stites	WQ parameters, summary statistics	Storet CD	1972-1992
13337200	Red Horse Creek near Elk City	Instant discharge, temperature, specific conditions	Earthinfo	5 days in 1970s
13337540	Leggett Creek near Golden	Instant discharge, temperature, specific conditions	Earthinfo	11 days in 1973-1981
13337700	Peasley Creek near Golden	Instant discharge, temperature, specific conditions	Earthinfo	11 days in 1973-1981
13338200	Sally Ann Creek near Stites	Instant discharge, temperature, specific conditions	Earthinfo	5 days in 1970s
209 Storet Stations	Throughout the subbasin	WQ parameters, summary statistics, most very limited	Storet CD	Limited, ending in 1998

[a]These sources are where data were found. They are not necessarily the only location or the most complete set of data for these stations. Earthinfo = http://www.earthinfo.com/ , USGS = U.S. Geological Survey, USGS Web site = http://waterdata.usgs.gov/nwis/sw/ , Storet = USEPA computerized data base (USEPA undated).

Table 20 shows that maximum flows in Lapwai Creek generally occur in April, while in the SF CWR Subbasin in general the maximum flows occur in May. The flows and sediment delivery calculations from Cottonwood Creek figure prominently in understanding flows and sediment in the SF CWR Subbasin. The mean daily flows for the 10 years (1992 through 2001) for Stites and Lapwai Creek (USGS data) and Threemile, Butcher, and Harpster Creeks (derived data) were used for the sediment TMDL calculations. The plots of those flows are presented in Chapter 5 as part of the sediment loading calculations.

Table 17. Flow data (cubic feet per second) for the SF CWR near Grangeville (#13338000), 1910-1963.

Month	Ave. Mean Monthly (cfs)	Max. Mean Monthly (cfs) (year)	Min. Mean Monthly (cfs) (year)
October	263	1,032 (1960)	104 (1937)
November	320	1,319 (1928)	101 (1937)
December	322	1,161 (1928)	117 (1936)
January	283	1,260 (1928)	94 (1937)
February	312	661 (1928)	119 (1937)
March	566	1,443 (1934)	197 (1955)
April	1945	3,390 (1943)	714 (1955)
May	3225	6,489 (1948)	932 (1934)
June	2197	4,821 (1948)	510 (1934)
July	654	1,716 (1955)	175 (1934)
August	218	413 (1948)	88 (1931)
September	191	386 (1959)	93 (1935)
Annual Mean	875	1,474 (1948)	494 (1937)

From a sediment loading and sediment loading exceedance point of view, the mean monthly flow rates are not the correct indicators of the major periods of sediment movement. As discussed in detail in Chapter 5, it is the few days of extreme high flows that occur at a five-year interval or less when the majority of sediment is moved in the SF CWR Subbasin. Table 21 shows the statistical frequency of these extreme high flows based on the complete records and USGS calculations (NWPP Council 2001), while Table 22 shows the dates and magnitudes of extreme events at the Stites and Harpster USGS stations.

Table 18. Flow data (cubic feet per second) for the SF CWR near Elk City (#13337500), 1944-1974.

Month	Ave. Mean Monthly (cfs)	Max. Mean Monthly (cfs) (year)	Min. Mean Monthly (cfs) (year)
October	70	263 (1960)	25 (1953)
November	90	247 (1969)	29 (1953)
December	97	285 (1959)	31 (1953)
January	99	428 (1969)	37 (1955)
February	109	373 (1968)	31 (1966)
March	176	479 (1972)	49 (1955)
April	662	1,216 (1969)	226 (1955)
May	1137	2,001 (1948)	413 (1973)
June	585	1,622 (1964)	207 (1973)
July	146	364 (1955)	74 (1966)
August	57	106 (1964)	27 (1961)
September	53	117 (1968)	25 (1953)
Annual Mean	274	401 (1965)	133 (1973)

The only high flow event at Lapwai that corresponds directly with the record at Stites is 1996, when the high flow at Lapwai was 5,010, the highest flow on record for the site. Other high flows at Lapwai were 2,200 cfs in December 1976; 2,050 cfs in February 1982; 3,380 cfs in February 1986; and 3,190 cfs in January 1997.

Not evident in the flow data presented above, but discussed in Chapter 5, is the timing and magnitude of extreme flows from Cottonwood, Butcher, and Threemile Creeks on sediment loading to the lower main stem of the SF CWR. The discordance between the flow regimes of Cottonwood, Butcher, and Threemile Creeks in relation to the rest of the subbasin leads to a special set of problems for sediment delivered into the main stem from these three tributaries.

Other flow data used in the TMDL calculations are those flow data collected at the time and location of the total suspended solids (TSS), bedload, biological, and chemical sampling. Those instantaneous flow data are presented in Appendix M with their associated water quality monitoring data.

Table 19. Flow data (cubic feet per second) for the SF CWR at Stites (#13338500), 1910-1912, 1964-1998.

Month	Ave. Mean Monthly (cfs)	Max. Mean Monthly (cfs) (year)	Min. Mean Monthly (cfs) (year)
October	282	677 (1976)	108 (1988)
November	358	893 (1969)	139 (1988)
December	460	2,365 (1976)	167 (1988)
January	540	1,665 (1969)	144 (1988)
February	655	2,211 (1996)	227 (1994)
March	996	2,387 (1978)	312 (1977)
April	2089	3,549 (1978)	807 (1973)
May	3312	5,528 (1976)	947 (1992)
June	2507	5,706 (1975)	463 (1992)
July	831	2,063 (1975)	314 (1973)
August	292	528 (1975)	137 (1973)
September	247	473 (1968)	115 (1987)
Annual Mean	1046	1,711 (1976)	451 (1992)

Table 20. Mean monthly flows (cubic feet per second) for the SF CWR at Elk City and Stites, and for Lapwai Creek at Lapwai.

Month	Elk City (cfs)	Stites (cfs)	Lapwai (cfs)
January	99	556	72
February	109	663	124
March	176	994	208
April	662	2070	223
May	1,140	3,420	136
June	585	2,660	54
July	146	821	17
August	57	289	8.2
September	53	262	12
October	70	292	17
November	90	354	24
December	97	463	61

Table 21. Magnitude and frequency of instantaneous peak flow at gaging stations in SF CWR Subbasin.

Station	Period of Record	Daily discharge (cubic feet per second) recurrence interval (years) and exceedance probability (%) based on indicated period of record							
		2 yr 50%	5 yr 20%	10 yr 10%	25 yr 4%	50 yr 2%	100 yr 1%	200 yr 0.5%	500 yr 0.2%
SF CWR Near Elk City	1945-74	1,940	2,610	3,050	3,610	4,030	4,440	4,870	5,430
SF CWR Near Grange-ville	1911-20 1923-63	5,040	6,800	7,990	9,540	10,700	11,900	13,200	14,900
SF CWR Near Stites	1964-99	6,470	9,480	11,600	14,400	16,500	18,800	21,100	24,300
Lapwai Cr. at Spalding	1975-97	798	1,880	2,960	4,800	6,590	8,770	11,400	15,700

Table 22. SF CWR instantaneous peak discharges (cubic feet per second) during major flood events.

Location	1933	1934	1938	1948	1957	1964	1974	1996
SF CWR near Grangeville	6,090	2,380	6,740	12,600	8,910	NA	NA	NA
SF CWR near Stites	NA	NA	NA	NA	NA	17,500	6.750	8,010

Subbasin-wide Water Column Data

Subbasin-wide water quality data is presented and discussed below.

Temperature

The temperature of stream water usually varies on seasonal and daily time scales, and differs by location according to climate, elevation, extent of streamside vegetation, and the relative importance of ground water inputs. Other factors affecting stream temperatures include solar radiation, cloud cover, evaporation, humidity, air temperature, wind, inflow of tributaries, and width to depth ratio. Diurnal temperature fluctuations are common in small streams, especially if unshaded, due to day versus night changes in air temperature and absorption of solar radiation during the day.

Aquatic species are restricted in distribution to a certain temperature range, and many respond more to the magnitude of temperature variation and amount of time spent at a particular temperature rather than an average value (MacDonald et al. 1991). Although species have adapted to cooler and warmer extremes of most natural waters, few taxa are able to tolerate very high temperatures. Reduced oxygen solubility at high water temperatures can compound the stress on fish caused by marginal dissolved oxygen concentrations.
Hourly stream temperatures were measured at various locations throughout the watershed during the summers of 1999 through 2001. Summary statistics for these data are presented in Appendix J. Water temperature criteria were exceeded in all streams monitored in at least one of the three years when monitoring was conducted. Figure 11 illustrates the most recent maximum weekly maximum temperature (MWMT) statistics for each site. Since the year that these data were collected may vary from site to site, this information should not be used to draw reach-by-reach comparisons; however, it is useful to illustrate the general pattern of stream temperature across the subbasin.

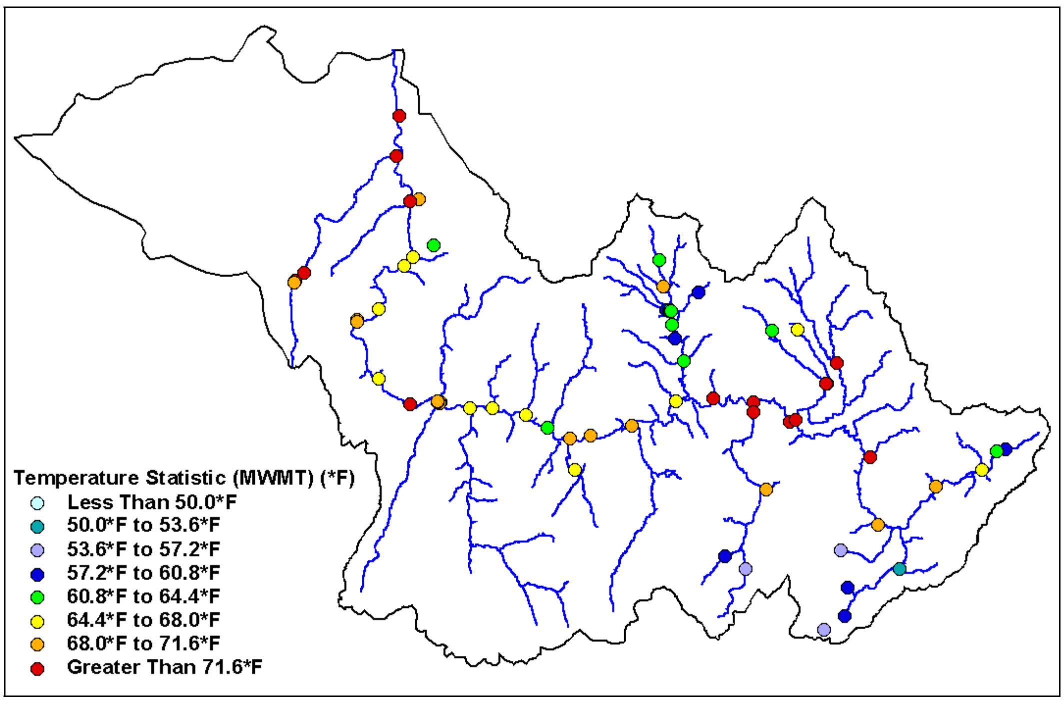

Figure 11. Recent Annual Maximum Weekly Maximum Temperature (MWMT) (°F) Temperature Statistic Values Observed in the SF CWR Subbasin

Main Stem Temperature Condition

Stream temperatures within the main stem SF CWR generally follow two distinct longitudinal (downstream) heating patterns: 1) water temperatures remain relatively stable in the upper reaches (river mile [RM] 65 through 23.1); and 2) water temperatures increase dramatically in bottom reaches (Figure 12). Tributary temperatures presented on this figure are generally less than main stem temperatures. Tributary temperatures presented in this figure are values observed at the mouth.

It is important to point out that water temperatures are already elevated at the headwaters (beginning) of the SF CWR, which originates from the combined flows of the American River and the Red River. Stream temperatures appear to decrease slightly as the river travels immediately downstream from the confluence. This indicates that factors influencing stream temperature conditions are dramatically different between the headwater reach of the Clearwater River (RM 65 through 23.1), and the American River and Red River systems.

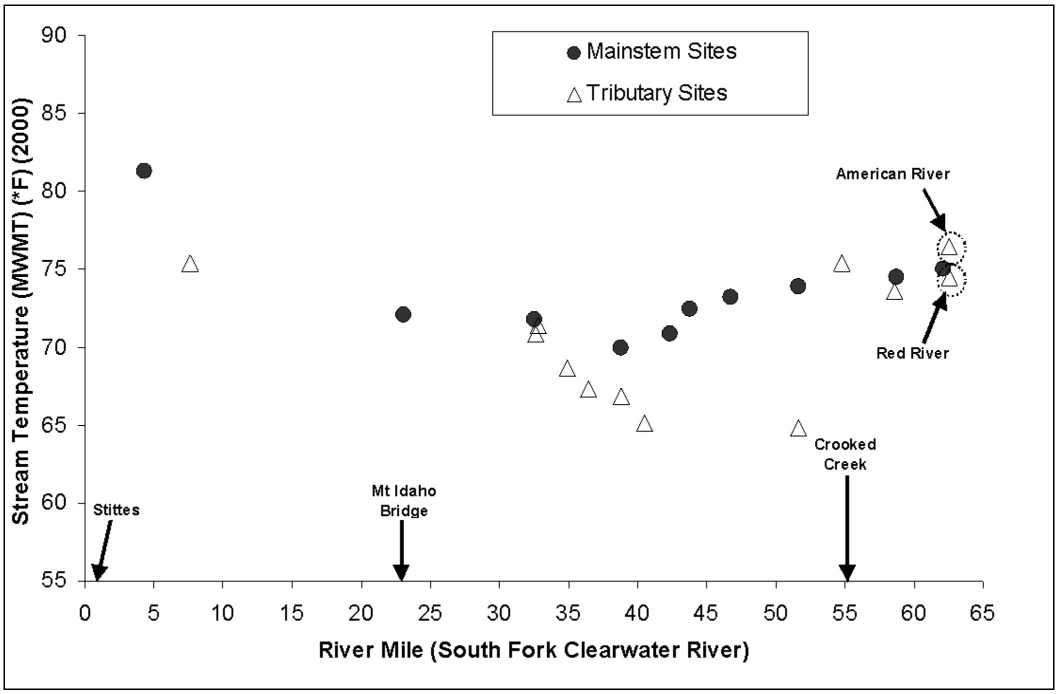

Figure 12. Maximum Weekly Maximum Temperatures Measured along the SF CWR Main Stem in 2000

Thermal Infrared Imaging

Thermal infrared imaging (TIR) was conducted on the SF CWR in order to measure river temperatures at a high spatial resolution. The TIR data were collected by specialized detectors attached to a helicopter during two flights on August 3, 2000. A detailed description of the methods used to collect and process this data is presented in the report, *Final Report - Paired Color Infrared and Thermal Infrared Imaging and Analysis for Selected Idaho Streams, Prepared for Idaho Department of Environmental Quality* (IRZ Consulting 2001).

Processed river temperature data for both the morning (approximately 8 a.m.) and the afternoon (approximately 6 p.m.) flights are presented in Figure 13. In addition, temperature data collected during the TIR flight period from ground-based monitoring are also presented in this image. As can be seen, TIR data collected during the morning corresponds closely with measured ground level data. However, afternoon TIR data appear to be elevated above measured values. It was reported in the TIR final report (IRZ Consulting 2001) that there was a discrepancy between instream calibration temperature data and stream temperatures calculated from the TIR data. Regardless, afternoon TIR data presented in Figure 13 can still be used to illustrate relative temperature trends along the main stem of the SF CWR. These trends correspond closely with heating trends observed in ground level data (Figure 12).

As can be seen in this image, stream temperatures increase dramatically downstream of the Mt. Idaho Bridge. In addition, the diurnal variability (i.e., the difference between morning and afternoon temperature) increased dramatically in these downstream areas. These results indicate that factors that influence stream temperature conditions, such as vegetative and topographic shade, width-to-depth ratio, and aspect, are dramatically different between these two sections of the SF CWR.

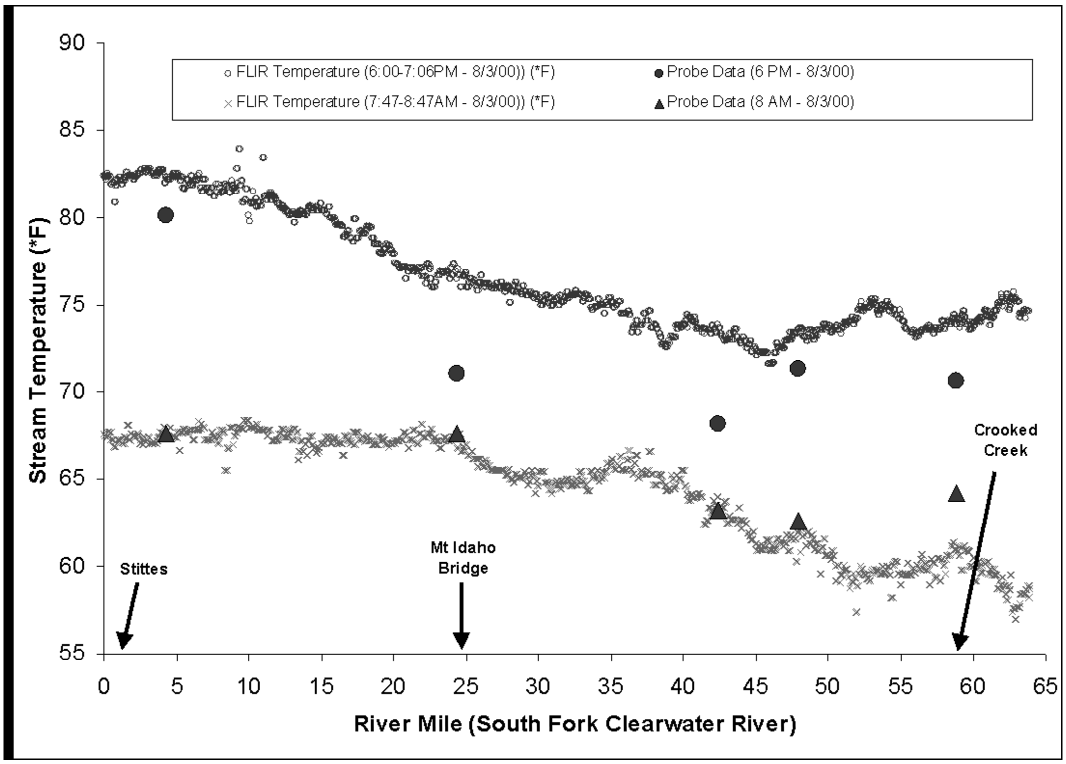

Figure 13. SF CWR Temperatures Derived from Instream Monitors and Remote Sensed Thermal Infrared Imaging (TIR a.k.a. FLIR) for August 3, 2000

Main Stem Diurnal Temperature Pattern

Measured stream temperatures within the main stem SF CWR on August 3, 2000, are presented in Figure 14. This is the same period of forward-looking infrared (FLIR)/TIR data collection (Figure 13). The diurnal profile presented in Figure 13 shows that temperatures remain relatively constant throughout the course of the entire day in the upper portions of the river. This indicates that very little stream heating (i.e., net energy input) is occurring within this section of the river. Water temperatures measured at the Mt. Idaho Bridge (RM 24.4) indicate that daily minimum water temperatures are elevated from values measured in upstream sites. This can indicate a gradient change between this site and upper sites, which would affect the amount of heat energy dissipation from the river into the surrounding environment during the non-daylight periods. It is important to point out that daily maximum temperatures are similar to upstream locations, indicating that stream heating processes between these locations are similar.

Daily maximum water temperatures increase dramatically on the SF CWR at the Stites monitoring location (RM 4.3). However, it is important to note that nighttime temperatures are identical to the upstream location at the Mt. Idaho Bridge (RM 24.4), indicating that these two sites are exposed to similar stream heating conditions during non-daylight periods. Daytime temperatures measured at the Stites location illustrate a dramatic heating profile, indicating large energy loads.

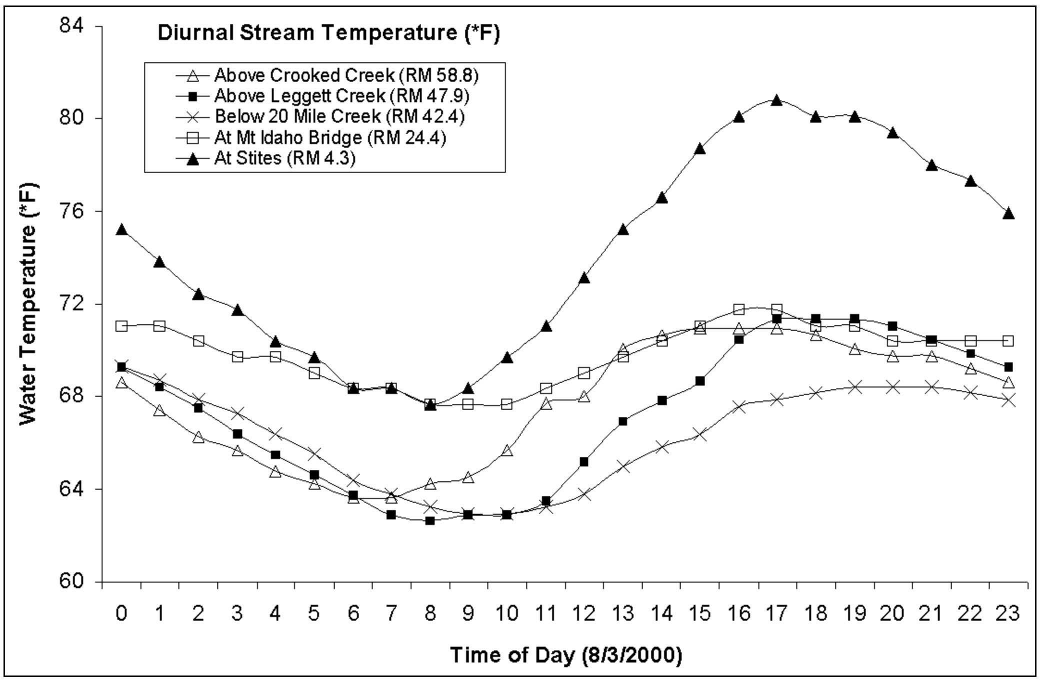

Figure 14. Observed Diurnal Temperatures in the Main Stem SF CWR on August 3, 2000

Red River Temperature Condition

As mentioned above, the SF CWR originates from the confluence of the American and Red River systems. Accordingly, upstream temperatures of the SF CWR are directly dependent on the temperature conditions within these two rivers. Measured stream temperatures observed within Red River are illustrated in Figure 15. This profile indicates a large increase in stream temperature within the upper reaches of this system (approximately RM 18 – 26), which are maintained until the mouth (i.e., confluence with the American River) and ultimately many miles downstream in the SF CWR (Figure 12). Figure 16 presents diurnal temperatures measured within Red River on August 3, 2000. The shape of the diurnal temperature profile remains relatively constant at all locations. However the diurnal range (i.e., minimum and maximum temperatures) increases as the river travels downstream, indicating greater heating conditions within these downstream reaches. Once again, elevated stream temperatures within this tributary are maintained throughout the entire length of the SF CWR.

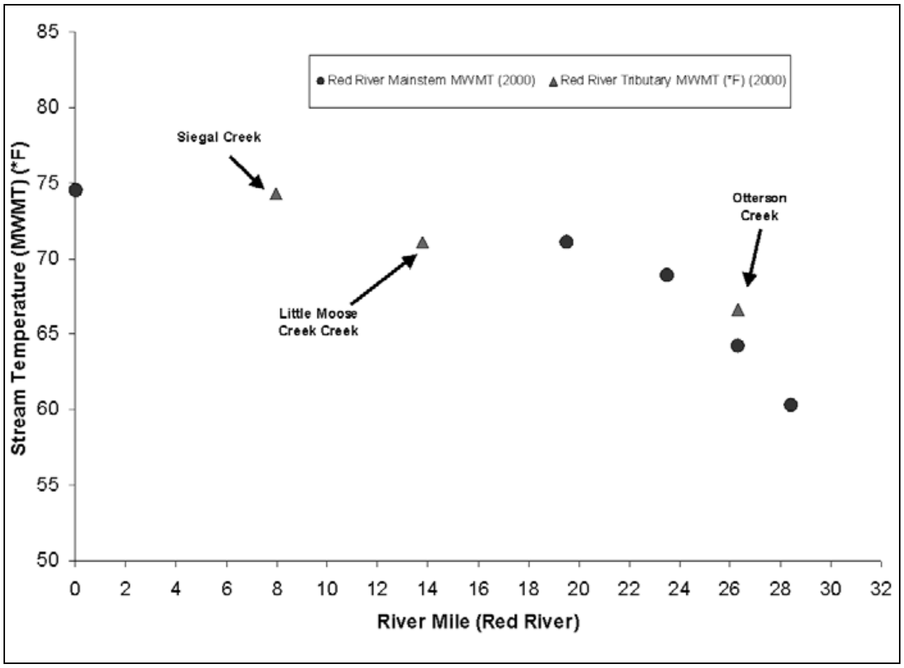

Figure 15. Maximum Weekly Mean Temperatures Measured along Red River in 2000

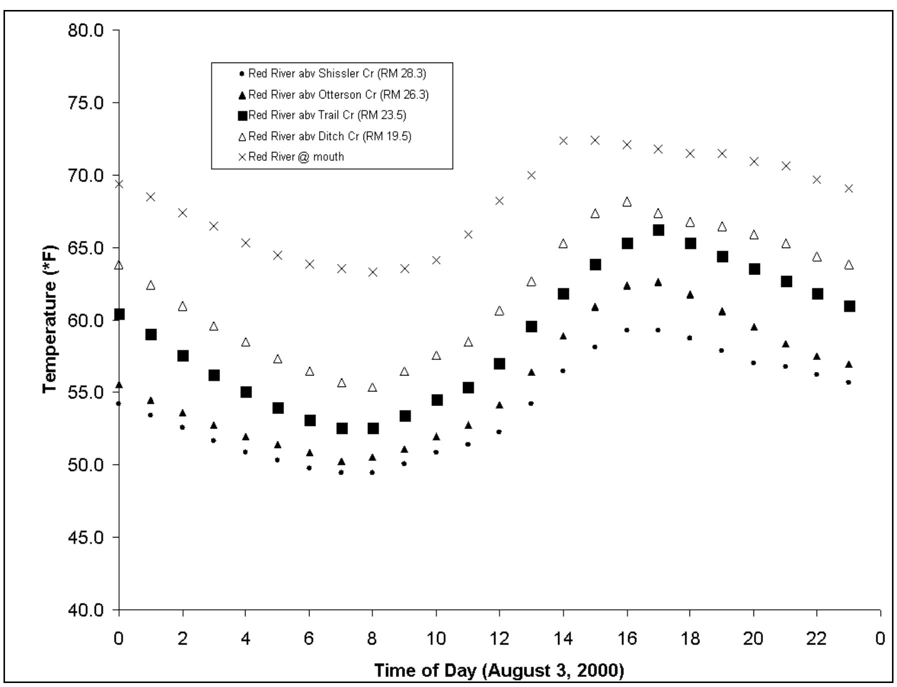

Figure 16. Observed Diurnal Temperatures in Red River on August 3, 2000

American River Temperature Condition

The American River is one of the two river systems that combine to form the main stem SF CWR. Accordingly, upstream temperatures of the SF CWR are directly dependent on the temperature conditions within the American River. Ultimately, American River water that enters the SF CWR is comprised of several tributary streams within the American River system (Figure 17). Temperatures illustrated on this figure show that water temperatures increase dramatically within lower meadow reaches of the river system. These elevated temperatures are maintained throughout the entire length of the SF CWR. Figures 18 and 19 illustrate that the diurnal temperature range increases dramatically within these lower reaches of this river system.

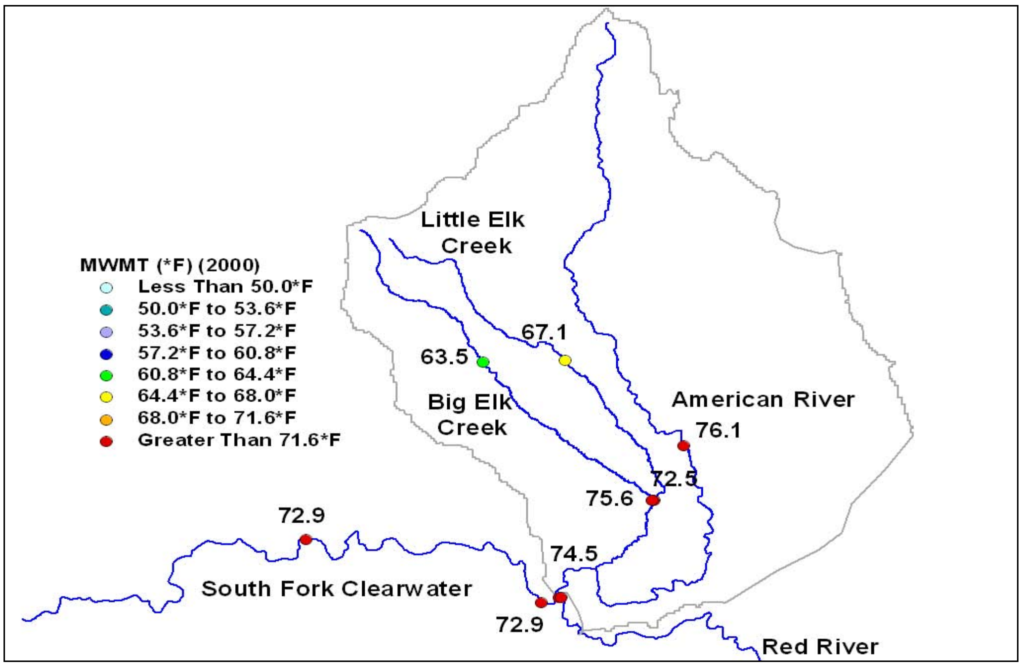

Figure 17. Measured Maximum Weekly Mean Temperature (^oF) in the American River System in 2000

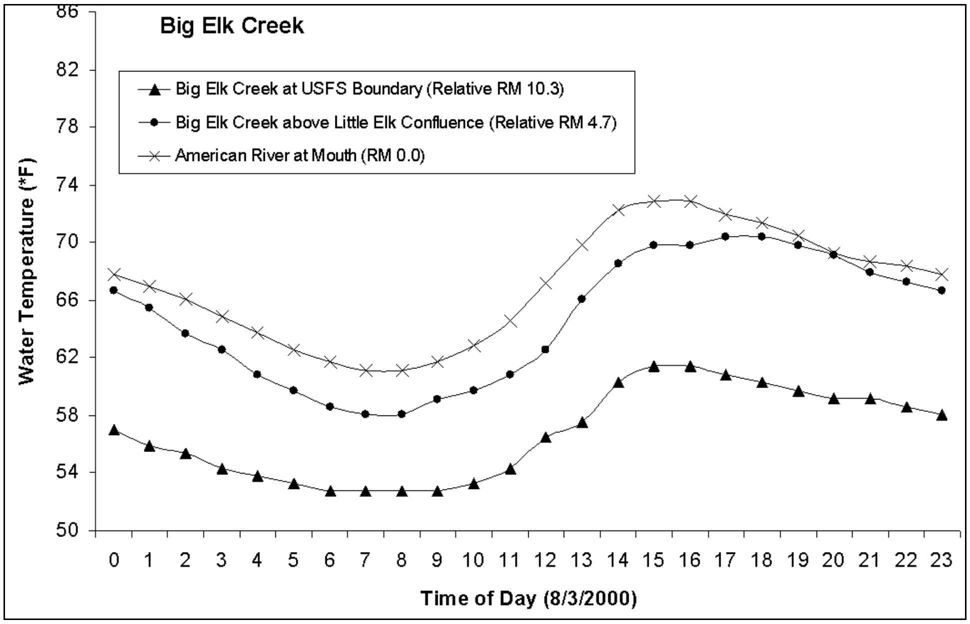

Figure 18. Diurnal Temperatures Measured in Big Elk Creek and the American River (mouth) on August 3, 2000

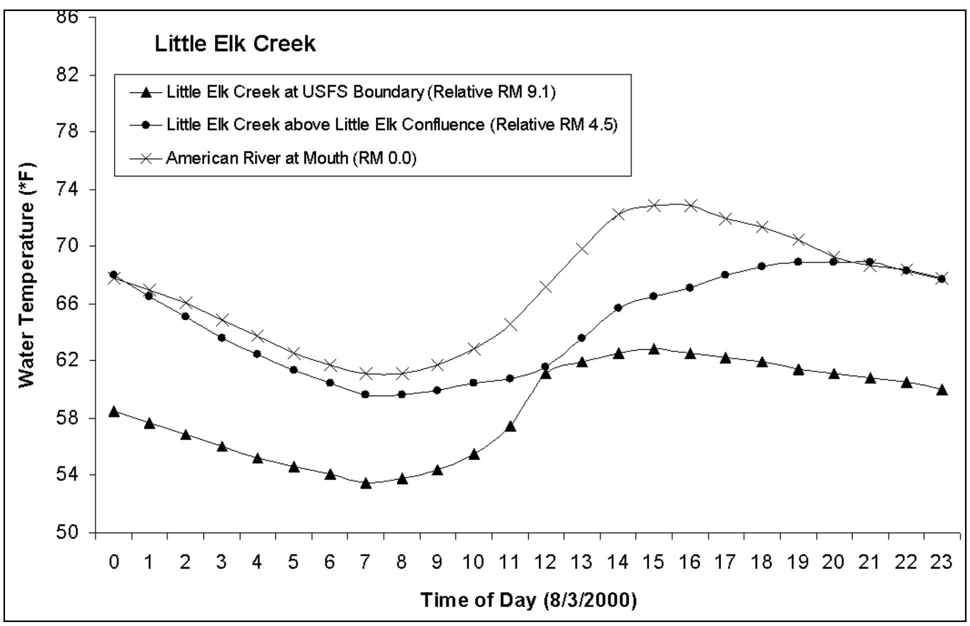

Figure 19. Diurnal Temperatures Measured in Little Elk Creek and the American River (mouth) on August 3, 2000

Threemile Creek Temperature Condition

Threemile Creek is an important tributary in the lower reaches of the SF CWR Subbasin. Figure 20 illustrates calculated MWMT temperature statistics for three sites on this stream system in 2000. As can be seen in this image, water temperatures are elevated throughout the system. It is impossible to determine water temperature conditions within headwater reaches of this creek because no data are available for this section of the stream. It could be assumed that stream temperatures in the forested headwater reach are lower than values measured near the city of Grangeville. This relationship was observed in other parts of the subbasin with "headwaters" data (Figure 11).

The diurnal temperature pattern within this stream shows that the Grangeville WWTP effluent discharging to the stream increased daily maximum temperatures on August 3, 2000, but more significantly, daily minimum temperatures were dramatically elevated at this downstream location on this date (Figure 21). The only conclusion that can be made from these three data sets is that river temperature was already elevated upstream from the WWTP effluent site (RM 12.9).

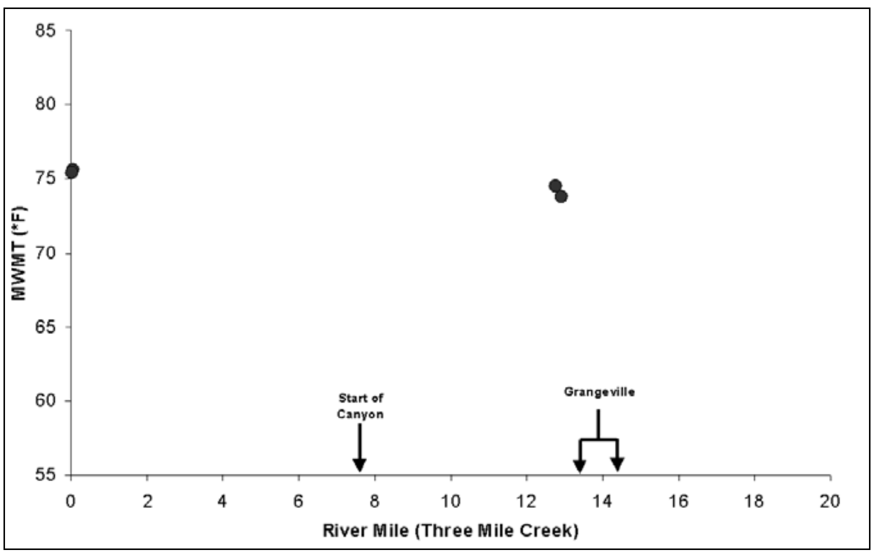

Figure 20. Maximum Weekly Mean Temperatures Measured in Threemile Creek in 2000

Seasonal Variation

Stream reaches within the SF CWR Subbasin experience prolonged warming starting in late spring and extending into the fall. Maximum temperatures typically occur in July and August (Figures 22, 23, and 24). The longitudinal downstream heating pattern described above is maintained throughout the summer period, as can be seen in these figures.

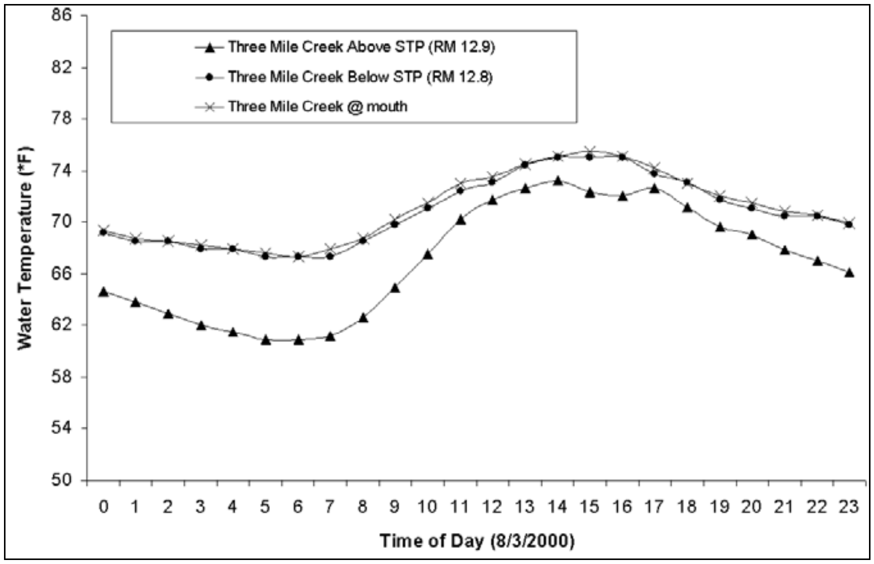

Figure 21. Diurnal Temperature Measured in Threemile Creek on August 3, 2000

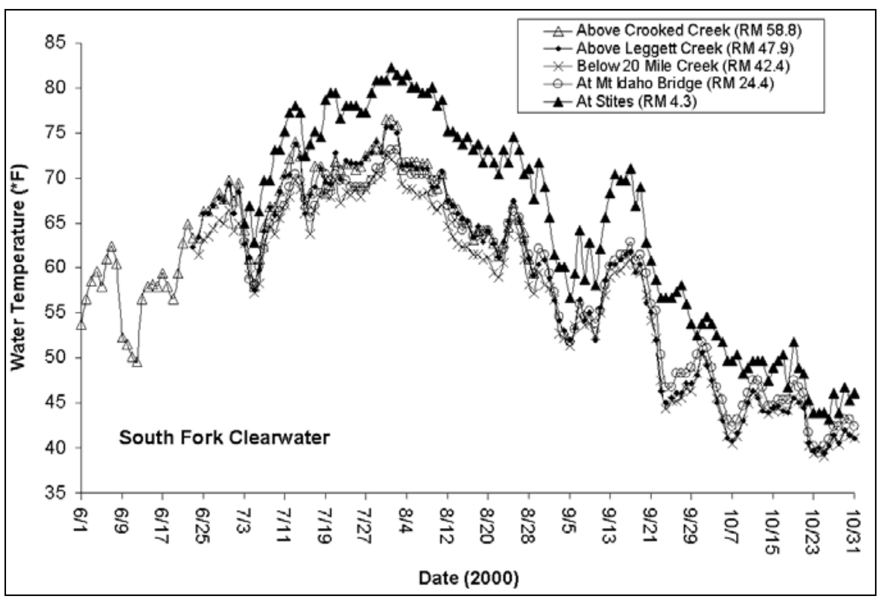

Figure 22. Seasonal Variations in Daily Maximum Temperatures in the SF CWR (Summer 2000)

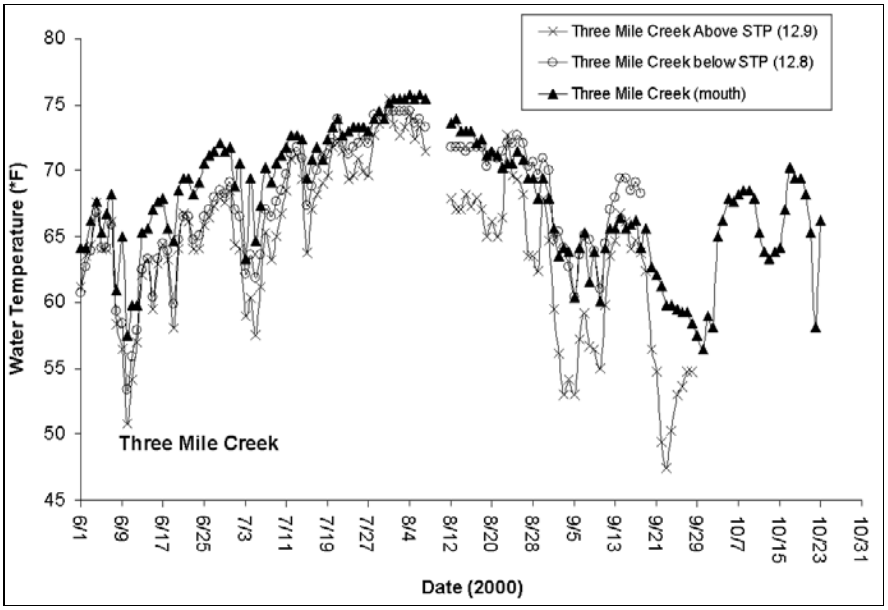

Figure 23. Seasonal Variations in Daily Maximum Temperatures in Threemile Creek (Summer 2000)

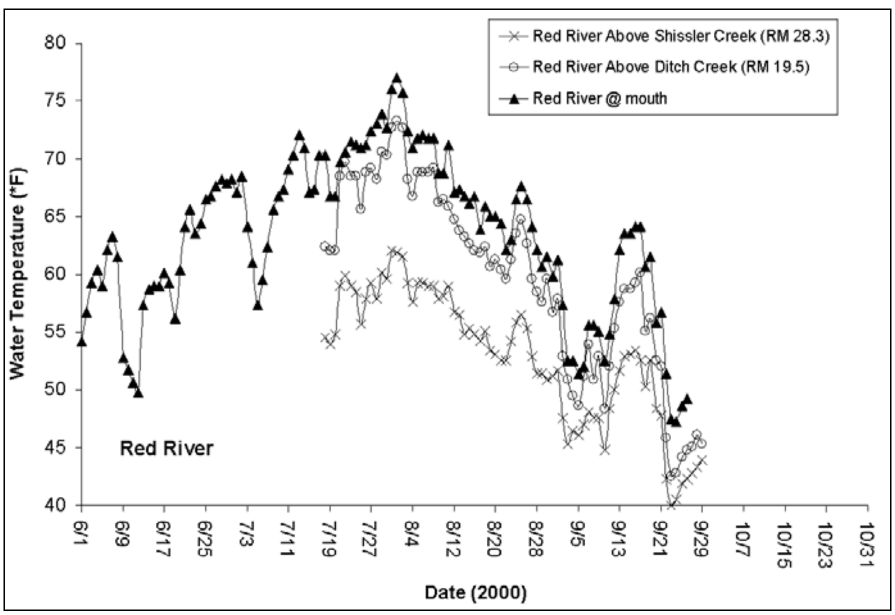

Figure 24. Seasonal Variations in Daily Maximum Temperatures in the Red River (Summer 2000)

Sediment

Sediment suspended in the water column can adversely affect aquatic life. Many fish species are adapted to the high suspended sediment levels of short duration that commonly occur during natural spring runoff events. However, longer durations of exposure can interfere with feeding behavior, damage gills, reduce available food, reduce growth rates, smother eggs and fry in the substrate, damage habitat, and induce mortality. Eggs, fry, and juveniles are particularly sensitive to suspended sediment, although at high enough concentrations adult fish are affected as well.

Turbidity is a measure of the extent to which light passing through water is scattered due to suspended material. The Idaho turbidity standard states that turbidity shall not exceed background by more than 50 NTU instantaneously or 25 NTU for more than 10 consecutive days.

Total suspended solids concentrations include the amount of solids suspended in the water, whether mineral (such as soil particles) or organic (such as algae). The TSS test measures the actual weight of material per volume of water. A comprehensive review of TSS criteria conducted by DEQ and USEPA (Rowe et al. 1998) suggests that 25 mg/L is a highly protective threshold for salmonids. This threshold can be variable but likely ranges from about 25 mg/L to 80 mg/L, depending on duration.

Bedload is material generally of sand size or larger that is carried by the stream on or immediately above its bed. Excessive bedload causes the loss of spawning and rearing habitat (i.e., cobble embeddedness, filling of pools, bed aggradation) and can lead to changes in channel width that then lead to increased temperature and reduction in aquatic habitat. The percentage of small gravel and finer particles less than 6.35 mm is often used as an indicator of habitat quality for salmonid fishes. Deposition of fine sediments in spawning substrate has been shown to be a major cause of embryo and larval mortality. Survival is high only if the eggs receive an adequate supply of DO, an adequate flow of water through the gravel to supply this oxygen, and necessary flows to remove metabolic wastes (Beschta and Platts 1986). Percent emergence of swim-up fry has also been shown to be reduced by fine sediment by a number of researchers. When particle sizes less than 6.35 mm reach 20-25% of the total substrate, embryo survival and emergence of swim-up fry is reduced by 50% (Bjornn and Reiser 1991).

When the fine textured bedload sediment is in excess of transport capacity, coarser particles on the stream substrate tend to become surrounded or partially buried (embedded) by sand and silt. Embeddedness quantitatively measures the extent to which the larger particles are embedded or buried by fine sediment. Areas with high embeddedness have very little space for invertebrates or juvenile fish to hide or seek protection from the current. Research has noted lower aquatic insect and salmonid fish densities in areas with high levels of cobble embeddedness. Levels above 30% are considered to indicate poor habitat conditions in the Clearwater River Basin (NMFS et al. 1998).

It is generally believed that many of the streams 303(d) listed as impaired by sediment may be impaired by both suspended sediment and bedload sediment, as they both affect salmonid spawning. However, at the beginning of our analyses, we found that water column data related to the hypothesized sediment pollution were few and disparate, and would have been very difficult to use for a systematic analysis. Therefore, the NPT, DEQ, and USEPA launched a monitoring effort to collect data on both TSS and bedload for the main stem of the SF CWR, Threemile Creek, and Butcher Creek. A reasonable data set had been collected and was available for Cottonwood Creek as a result of the TMDL there (DEQ, NPT, USEPA

2000). The additional monitoring effort for this TMDL resulted in bedload and TSS data for the SF CWR main stem at Stites and at a private bridge above Harpster, and TSS data for Butcher and Threemile Creeks. These data, along with the derived rating curves, are presented in Appendix M. Reasonable sediment rating curves were developed for both bedload and TSS for the Harpster and Stites locations, and for TSS at the Butcher and Threemile locations. The total bedload for Threemile and Butcher Creeks was derived from instream erosion data and is discussed in Chapter 3 as a pollution source.

Chapter 5 presents the sediment loading calculations, wherein the sediment rating curves are coupled with the daily flow records to identify whether turbidity exceeds the state WQS. Appendix M shows the development of the relationship at each site between turbidity and TSS. This sets the stage for relating the WQS of 25 NTU above background over 10 days to loading calculations of TSS. The excess TSS loads plotted in Figure 25 are the sediment loads above the load capacities based on the 25 NTU standard. Generally, the exceedances occur in the January through May time period during the times when extreme high flows occur. Figure 25 also includes blow-ups of two years' data to show that the exceedances do occur in relatively narrow time frames in the January through May critical time period. These are episodic events so they cannot be predicted any more closely.

The data indicate that TSS exceedances do not occur at Harpster. Based on these limited data, it appears that TSS is not a pollutant of concern above Harpster. The TSS-based loading allocations are indicated for Threemile and Butcher Creeks, and the lower main stem water body of the SF CWR

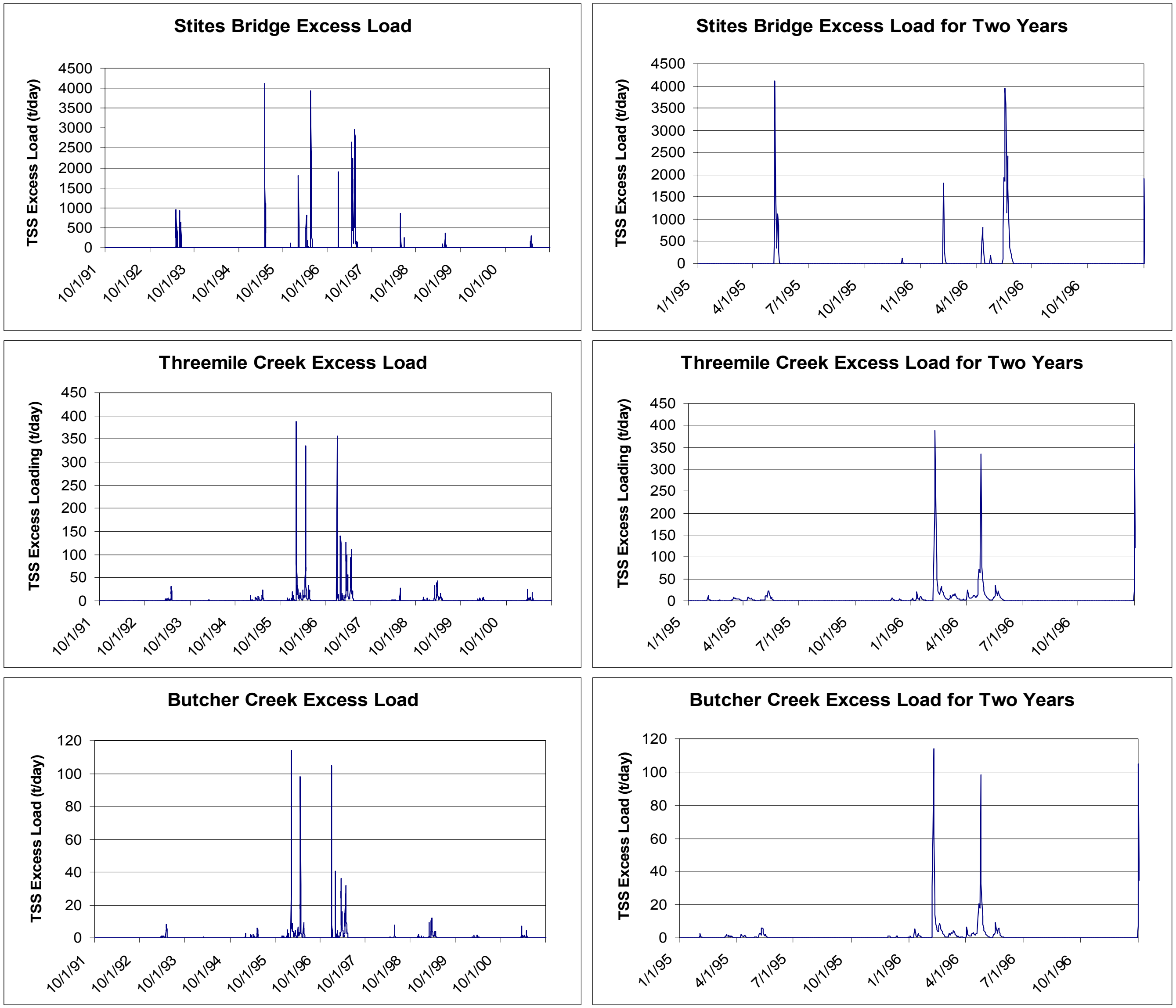

Figure 25. Total Suspended Solids Excess Loads for Stites, Threemile Creek, and Butcher Creek

Conclusions from the Water Column Data for the SF CWR Subbasin

The temperature data presented in Appendix J clearly show that all of the water bodies in the SF CWR Subbasin monitored for temperature exceed the state WQS. It is likely that most if not all, of the water bodies in the subbasin exceed the temperature standards. A temperature loading analysis is warranted for the whole subbasin. The loading analysis will include point sources for temperature problems. It will also include consideration that some level of temperature standards exceedance is probably a natural condition in the SF CWR Subbasin. The critical time period for the water temperature analysis is during the months of July and August when air temperatures and water temperatures are highest, and when water flows are lowest. Although stream temperature problems occur throughout the subbasin, the Fish TAG identified those water bodies with the most critical temperature problems (Appendix D).

Turbidity, TSS, and flow data for Threemile Creek, Butcher Creek, and the lower main stem SF CWR show exceedances of the WQS during periods of high flows throughout the three water bodies. The periods of high flows occur episodically during January through May. The exceedances occur with both fine and coarse sediment. Indicators of use impairment are cobble embeddedness, bank instability, and a lack of pools in Threemile and Butcher Creeks, and a lack of pools and cobble embeddedness in the main stem SF CWR. Sediment TMDLs need to be developed for Threemile Creek, Butcher Creek, and the lower main stem SF CWR.

For the 303(d) listed water bodies upstream from the mouth of Butcher Creek, water quality limitations in relation to the WQS are much less clearly indicated by the data. Existing TSS data coupled with flow data, presented in Chapter 5, indicate that the main stem and streams upstream from Harpster are meeting the turbidity water quality standards. The general consensus is that any water quality impairment upstream from Harpster is the result primarily of sand-sized material.

Overall, the evidence is mixed whether a sediment loading analysis and TMDL is warranted for the water bodies upstream from Harpster. WBAG assessments of BURP data from the 303(d) listed as well as all other water bodies above Harpster indicate that beneficial uses are being supported. WBAG assessments are not available for the main stem water bodies for lack of an appropriate data set and/or approved assessment tools. The sediment budget developed in Appendix L identifies some of the 303(d) listed tributaries as having above average sediment loading rates for the subbasin. However, the highest sediment loading rates are for the main stem water bodies, and some non-303(d) listed tributaries. Except for the main stem and middle Red River water bodies, all others in the upper basin have sediment loadings less than 50% over natural background. Average cobble embeddedness rates throughout the upper basin and main stem are elevated both in relation to reference watersheds and generally accepted levels of cobble embeddedness for good salmonid spawning. The Fish TAG identified self-supporting populations of salmonids throughout the upper basin, but also identified about half the water bodies in the upper basin as being limited by sediment.

In the final analysis, the three parties considered all lines of evidence, including information and input from the WAG and resource professionals, in relation to the state WQS. The three parties could not agree on the need to write sediment TMDLs for the upper tributaries. The parties did agree, however, that a sediment TMDL is warranted for the upper SF CWR main stem and that land managers should be encouraged to reduce sediment loading throughout most of the managed portions of the subbasin, including tributaries, to improve salmonid habitat in the upper basin and contribute to the load reductions needed for the upper and lower reaches of the main stem. To accomplish these goals, loading analyses should be completed for control locations at the pour points for each of the four main stem water bodies upstream from Butcher Creek. Load reductions of human-caused sediment for each of these control locations should be proportionate to the load reduction calculated for the Stites control location. Sediment load reduction allocations for each of the four locations will be gross load reduction allocations, leaving the where and how of the load reductions to the discretion of the WAG and local land managers.

For the sediment analysis of the upper main stem water bodies, the critical flow period is the same as downstream water bodies: those episodic times of very high flow conditions that occur from January through May. While it is generally believed that the primary impairment to salmonid spawning is sand-sized bedload sediment, loading analyses will be for the whole sediment load with the assumption that reducing the whole sediment load will result in the necessary reduction of bedload.

Summary and Analysis of Existing Water Quality Data for Threemile Creek and Butcher Creek

Threemile Creek and Butcher Creek are 303 (d) listed for a number of pollutants in addition to sediment and temperature, including bacteria, dissolved oxygen, nutrients, and ammonia (Threemile Creek only). These additional pollutants are discussed below for each of these two water bodies.

Threemile Creek

Threemile Creek has been designated by the state of Idaho for salmonid spawning and secondary recreation beneficial uses. The salmonid spawning WQS apply over the entire reach of the creek. There are portions of the creek not far from the mouth blocked by landslides, where the creek travels subsurface, which restricts fish migration during low flows. In addition, a series of 2-meter falls occurs approximately 9.5 kilometers upstream from the mouth, which may limit fish passage on a seasonal basis. Fuller et al. (1984) documented rainbow/steelhead above this potential barrier at stream kilometer 10.3.

Threemile Creek data were collected biweekly (February 2, 2000, through January 22, 2001) by DEQ at the six monitoring sites shown in Figure 26. Parameters sampled included continuous temperature at the mouth, flow, pH, DO, turbidity, TSS, total and ortho-phosphorous, nitrates and ammonia, and *E. coli* and coliform bacteria. Sporadic measurements were taken at sites called “Big Barn” and “Headwaters.”

Butcher Creek

Butcher Creek beneficial uses are currently undesignated by the state of Idaho. Prior to designation, according to Idaho Code, "undesignated waters shall be protected for beneficial uses, which includes all recreational use in and on the water and the protection and propagation of fish, shellfish, and wildlife, wherever attainable" (IDAPA 58.01.02.101). Studies by the NPT and DEQ (Fuller et al. 1984, DEQ 1995, NPT 2002) have established salmonid spawning as an existing beneficial use. Butcher Creek also has the beneficial uses of primary and/or secondary contact recreation.

The salmonid spawning water quality criteria apply over the entire length of the Butcher Creek, although there is a series of falls approximately 6 miles upstream from the mouth that may limit fish movement upstream. This TMDL will use the mouth of the creek as the point of compliance for meeting salmonid spawning water quality criteria.

Butcher Creek data were collected by the NPT monthly (February 27, 2001, through February 26, 2002) approximately 1 mile upstream from its confluence with the SF CWR. Parameters sampled included continuous temperature at the mouth, flow, pH, DO, turbidity, TSS, total and ortho-phosphorous, nitrates and ammonia, and *E. coli* and coliform bacteria.

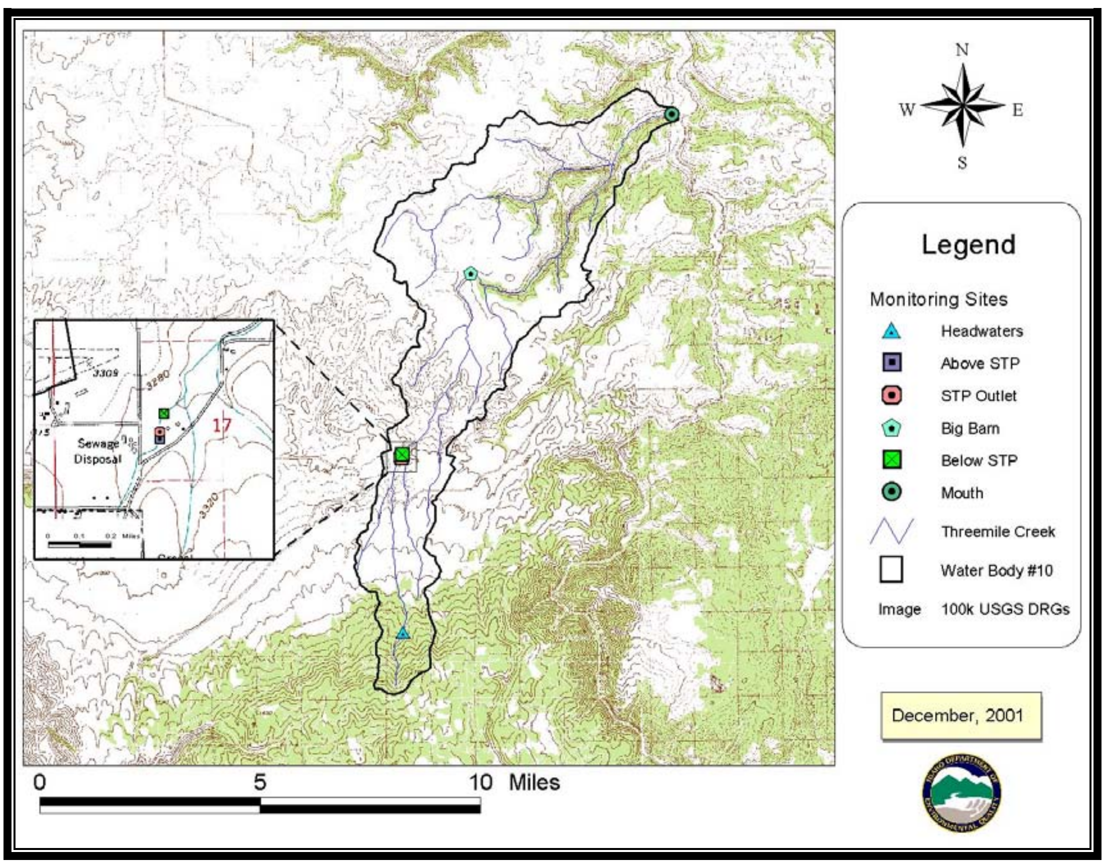

Figure 26. Monitoring Sites on Threemile Creek

Flow Characteristics

Instantaneous flows collected while monitoring Threemile Creek and Butcher Creek are shown in Figures 27 and 28. Appendix M shows flow curves for the two creeks based on extrapolation of these data and flow data from Lapwai Creek.

The minimum flow for all sites on Threemile Creek was measured on August 8, 2000, and the maximum flow was measured on May 16, 2000 (Table 23). Although there was consistent flow above the WWTP outfall, on two occasions the flow at the WWTP outfall was greater than or equal to the flow below the outfall. On the average, the outfall contributed 43% of the flow below the outfall. It contributed 30% of the flow, 50% of the time.

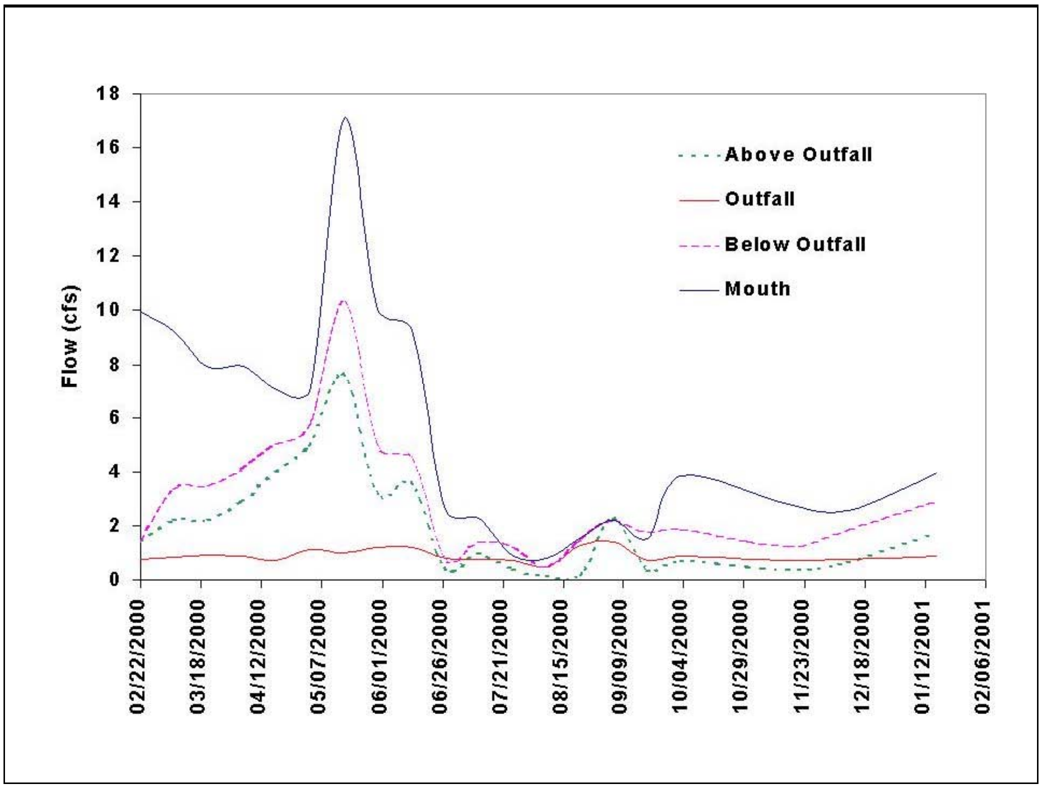

Figure 27. Stream Flow at Four Monitoring Points on Threemile Creek

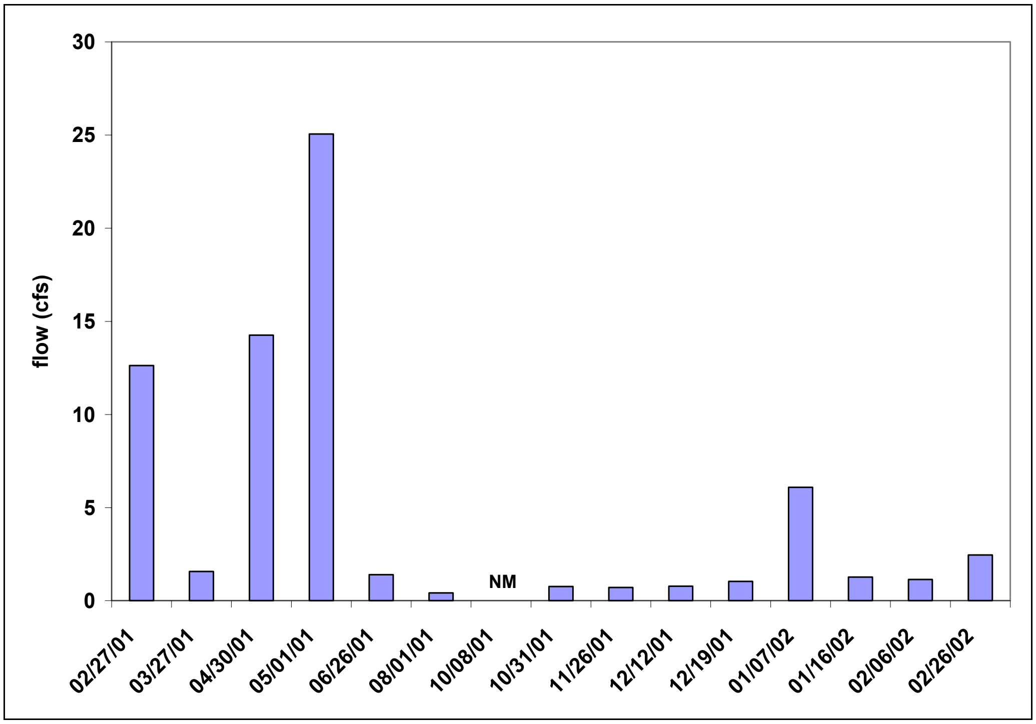

Figure 28. Flows Monitored in Butcher Creek

Table 23. Monitored flows in Threemile Creek from February 22, 2000, to February 6, 2001.

	Above Outfall	Outfall	Below Outfall	Mouth
Mean (cfs)[a]	2.01	0.90	3.32	5.51
Maximum (cfs)	7.60	1.38	10.35	17.09
Minimum (cfs)	0.14	0.49	0.49	0.81

[a] cubic feet per second

During the entire monitoring period (February 2000 through February 2001) the area received near average precipitation, and temperatures were slightly higher than normal (Figure 29). However, during the summer, the region experienced lower than normal precipitation and higher temperatures.

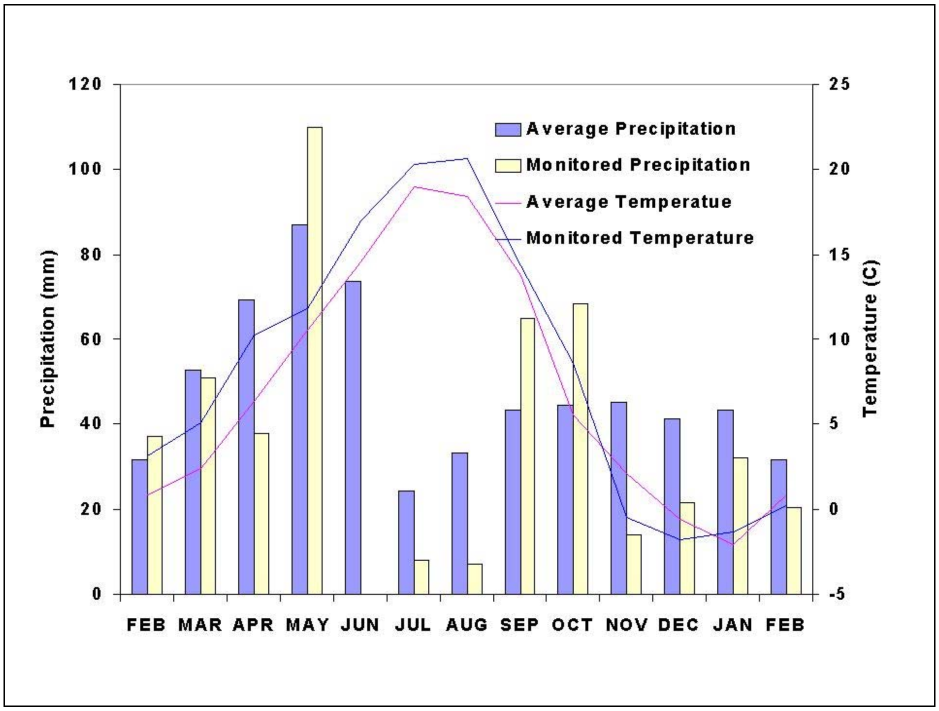

Figure 29. Measured Monthly Temperature and Precipitation vs. 40 Year Monthly Averages for Temperature and Precipitation

Peak flows occurred during the spring due to snowmelt. The WWTP outfall volume is nearly constant year round, with an average of 0.90 cfs. The flow at the mouth was greater than 1.0 cfs during most of the year, except during late July and early August when the discharge measured only 0.81 cfs. Immediately below the WWTP outfall, stream flows were above 1.0 cfs except for one June day when the discharge measured 0.76 cfs. However, the monitoring point below the outfall may not be representative of upper Threemile Creek. The WWTP is a constant source of water and adds a significant portion of the flow during the summer and fall months.

Pathogens

Pathogens are a small subset of microorganisms (e.g., certain bacteria, viruses, and protozoa), which if taken into the body through contaminated water or food, can cause sickness or even death. Some pathogens are also able to cause illness by entering the body through the skin or mucous membranes.

Direct measurement of pathogen levels in surface water is difficult because pathogens usually occur in very low numbers and analysis methods are unreliable and expensive. Consequently, indicator bacteria which are often associated with pathogens, but which generally occur in higher concentrations and are thus more easily measured, are assessed. *E. coli*, a type of fecal coliform bacteria, are used by the state of Idaho as the indicator for the presence of pathogenic microorganisms.

The major sources of pathogens in the watershed include livestock grazing, confined livestock management, wild game and waterfowl, and failing septic systems. Animals dependent on the stream as a water source contribute bacteria directly to the stream in addition to breaking down stream banks and grazing on streamside vegetation. This results in reduced stream buffering and a increased likelihood of wastes entering the stream. Because fecal coliform can survive for long periods of time in the stream substrate, bacterial numbers may be influenced by past activities and can be resuspended by stream flow or animal disturbance. *E. coli* counts may also increase with storm and runoff events, as pathogens are washed into the stream. Figure 30 shows the measured *E. coli* bacteria collected from Threemile Creek during the 2000-2001 monitoring period.

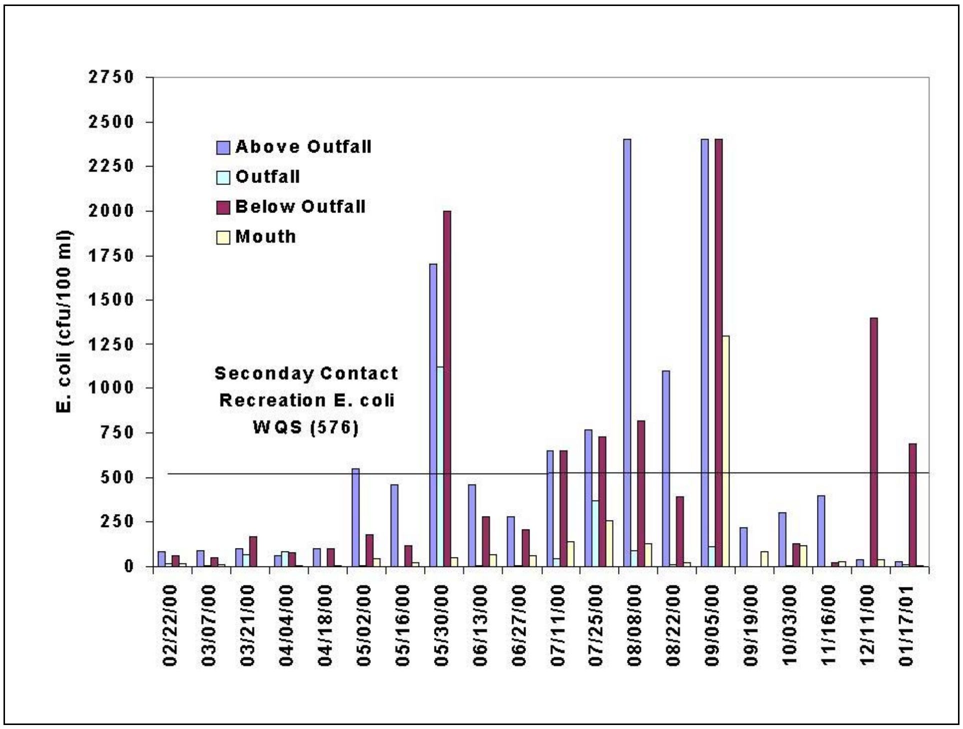

Figure 30. *E. coli* Bacteria Monitoring Results for Threemile Creek

The state of Idaho criteria for *E. coli* are not to exceed 126 colony forming units (cfu) per 100 ml as a monthly mean or 406 cfu per 100 ml as an instantaneous sample for primary contact recreation. The secondary contact recreation criteria are the same as primary contact recreation for the monthly mean, and not to exceed 576 cfu per 100 ml for an instantaneous sample.

Threemile Creek is designated for secondary contact recreational use by the state of Idaho. The instantaneous criterion for *E. coli* concentrations is not to exceed 576 organisms per 100 ml at any time. Eighteen exceedances of secondary contact criteria were documented at the Threemile Creek monitoring sites: eight located at the site above the WWTP outfall, one at the WWTP outfall, seven below the WWTP outfall, one at the Big Barn, and one at the mouth. Generally high bacterial counts occurred during high stream flow (storm events). Potential bacteria sources include storm water runoff from the city of Grangeville, livestock grazing and/ or confinement adjacent to the creek, waterfowl and wild game, and failing septic systems.

The WWTP is also a source of bacteria, but the concentrations are generally low. Historically, a few exceedances of the fecal coliform permit limits occurred, but in recent years fecal coliform concentrations have been well within the permit compliance limits of 100 cfu/100ml. Low levels of fecal coliform are routinely detected in the WWTP effluent although it is chlorinated.

Butcher Creek had no instantaneous exceedances of either primary or secondary contact recreation during the 15-month sampling period (Figure 31). The highest *E. coli* levels (instantaneous counts of 250 and 160) were associated with high flows and exceeded the monthly average target of 126 cfu per100 ml. This may indicate bacteria entering the stream as a result of overland flow from rain events. Best management practices (BMPs) that reduce sediment and heat loading in Butcher Creek may also reduce levels of bacteria. These activities may include the removing cattle from areas of the creek, fencing, and re-establishing riparian buffer zones. Although a TMDL is not warranted at this time for pathogens, monitoring should continue to observe for potential exceedances.

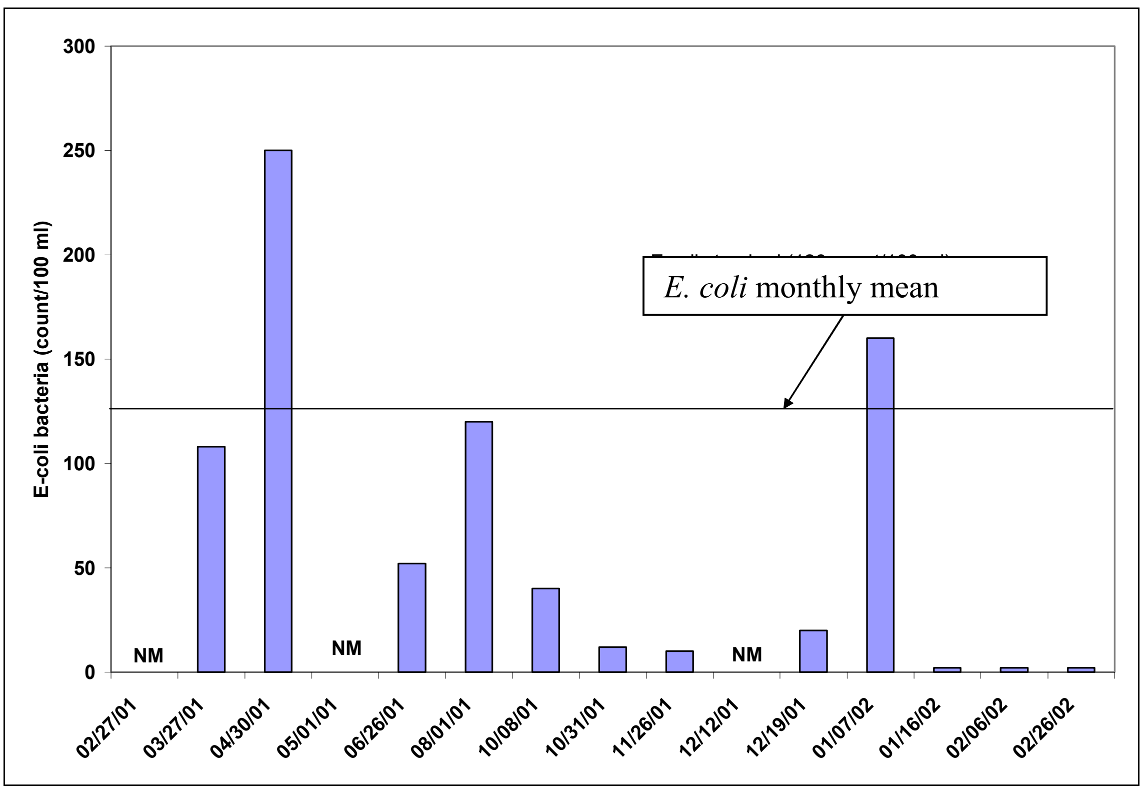

Figure 31. *E. coli* Monitoring Results for Butcher Creek

Dissolved Oxygen

The Idaho criteria for DO in the water column for cold water aquatic life and salmonid spawning is a one-day minimum of not less than 6.0 mg/L or 90% saturation, whichever is greater. The criteria for intergravel DO for salmonid spawning is 6.0 mg/L or greater for a weekly mean and 5.0 mg/L or greater for a daily minimum. The DO levels in a stream may be reduced by excessive nutrient loading and consequent algae growth. The biological decomposition of algae utilizes oxygen and may deplete it under low flow conditions.

Instantaneous DO levels in Threemile Creek were very close to a criteria deficiency during three sampling events at the mouth (July 25, 2000 – 6.07 mg/L; August 8, 2000 – 6.03 mg/L; and August 22, 2000 – 6.40 mg/L) (Figure 32). The results from this study are inconclusive and follow-up studies will be undertaken in the future.

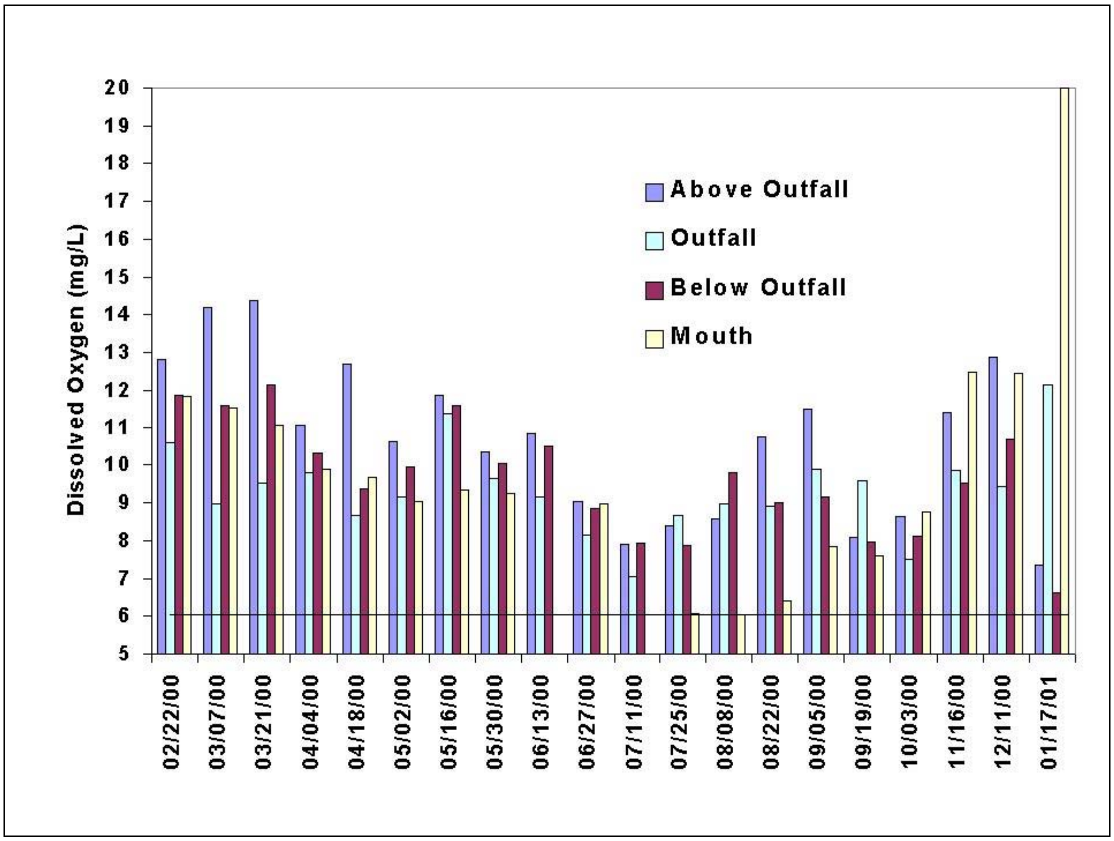

Figure 32. Dissolved Oxygen Monitoring Results for Threemile Creek

Butcher Creek instantaneous DO levels ranged from 10.1 to 19.9 mg/L during the 15-month monitoring period (Figure 33). While these data show an adequate amount of DO in the water column, no diurnal measurements were taken to determine the range of DO throughout the day. However, as the levels of phosphorous and nitrogen in Butcher Creek are not likely to stimulate nuisance algae growth during the critical time period (summer growing season), and DO levels were well above the 6.0 mg/L criteria for all sampling dates, a DO TMDL is not warranted at this time.

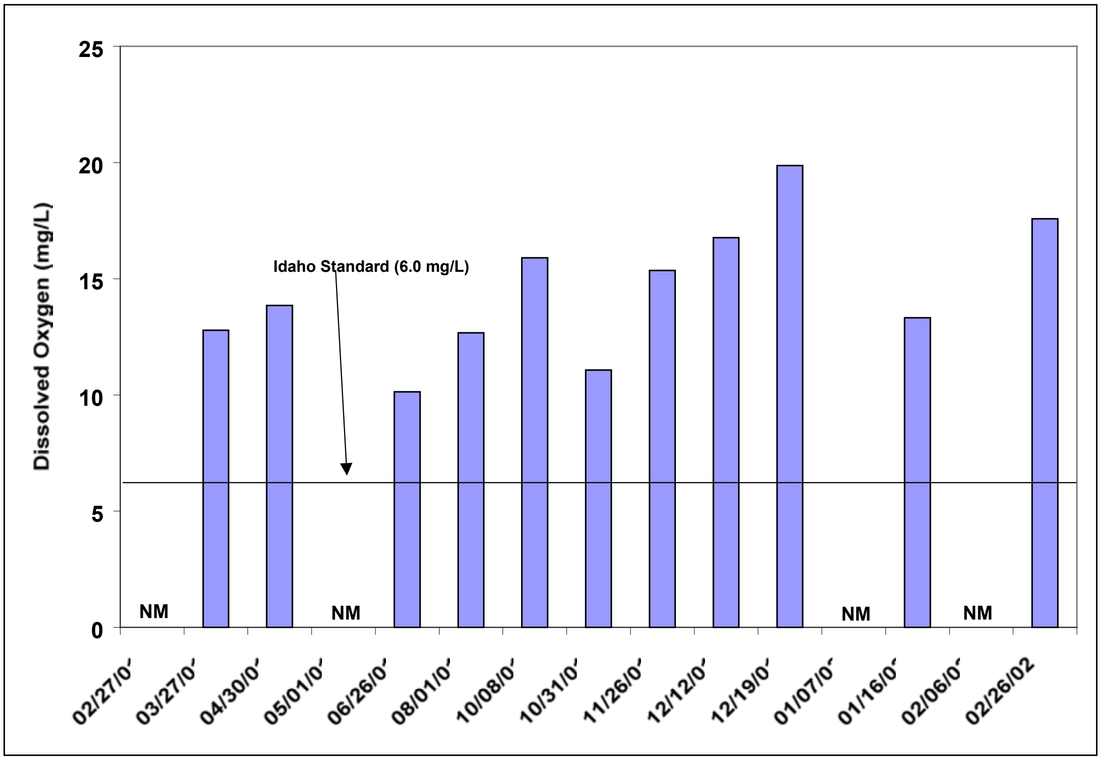

Figure 33. Dissolved Oxygen Monitoring Results for Butcher Creek

Ammonia

Ammonia was measured in Threemile Creek and Butcher Creek as total ammonia, which combines the forms of dissolved gas, ammonium hydroxide, and the ammonium ion. Ammonia can be both toxic to aquatic animal life and provide a source of nitrogen to plants. As temperature and pH increase in the stream so will the total ammonia level. The critical period for salmonid spawning is April through October. The Idaho criteria establishes ammonia limits depending on pH and water temperature. None of the ammonia concentrations shown in Figure 34 exceed the WQS.

The Grangeville WWTP National Pollution Discharge Elimination System (NPDES) permit allows releases up to 5.0 mg/L total ammonia as N into Threemile Creek. The WWTP exceeded its limit once during the monitoring period.

The ammonia criteria were never exceeded in Butcher Creek (Figure 35), although during August the temperature, pH, and ammonia levels were high (See Figures 35 and 37).

Both Threemile and Butcher Creeks, therefore, appear to be in compliance with the WQS for ammonia and no TMDLs for ammonia will be developed. It is recommended that Threemile Creek be removed from the 303(d) list for ammonia.

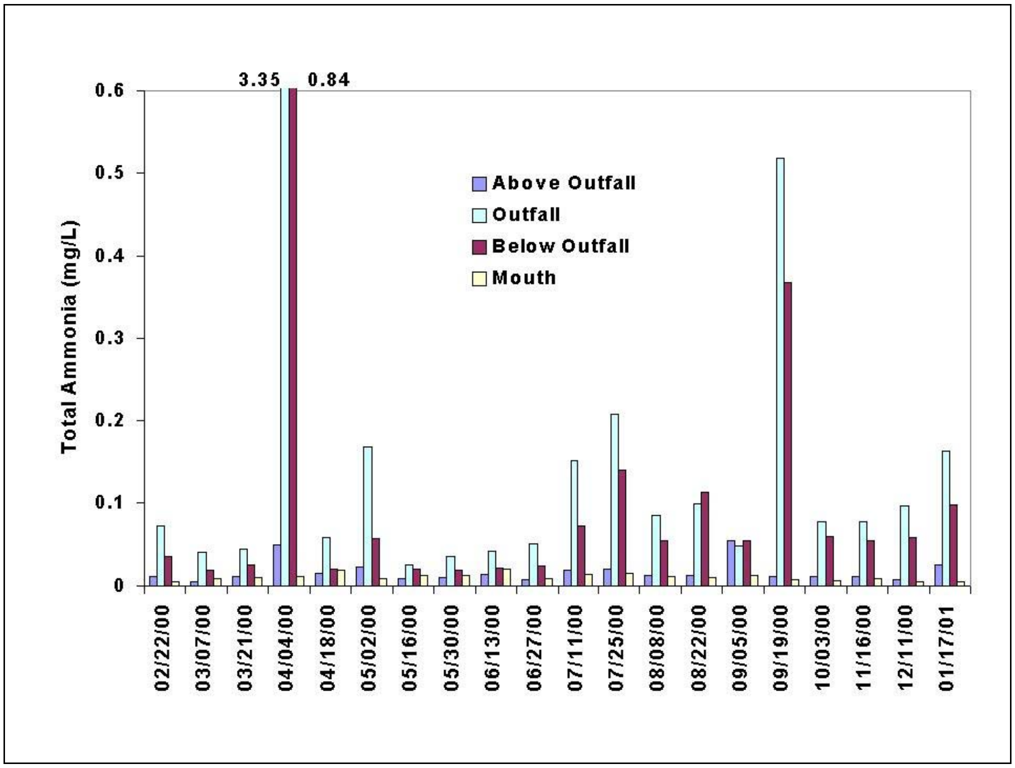

Figure 34. Total Ammonia Monitoring Results for Threemile Creek

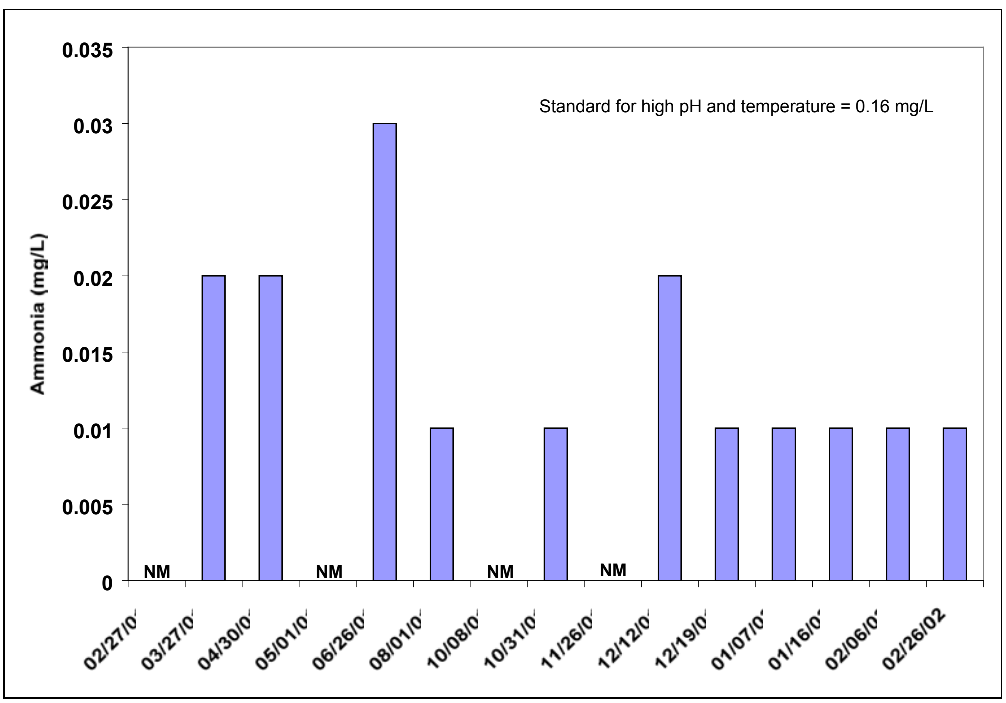

Figure 35. Total Ammonia Monitoring Results for Butcher Creek

pH

Threemile Creek pH levels ranged from 6.21 to 8.88 at the mouth. Generally, pH averaged 7.6 for all the Threemile Creek sites at all times of the year with little seasonal fluctuation (Figure 36). Butcher Creek's pH ranged from 7.5 to 8.64 for the sampling period (Figure 37). Generally the pH averaged 8.1 at all times of the year with little seasonal fluctuation.

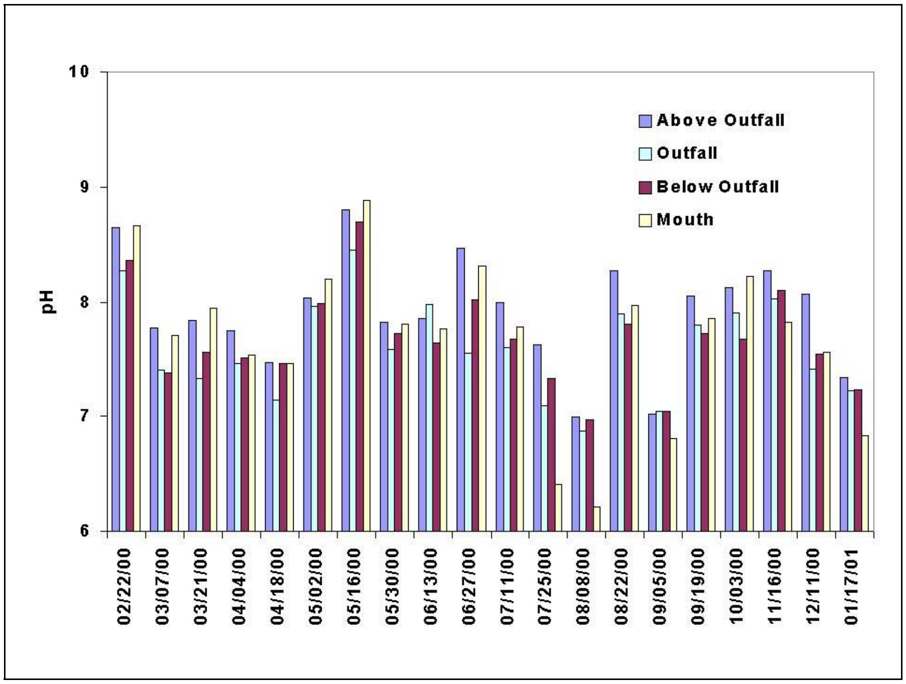

Figure 36. pH Monitoring Results for Threemile Creek

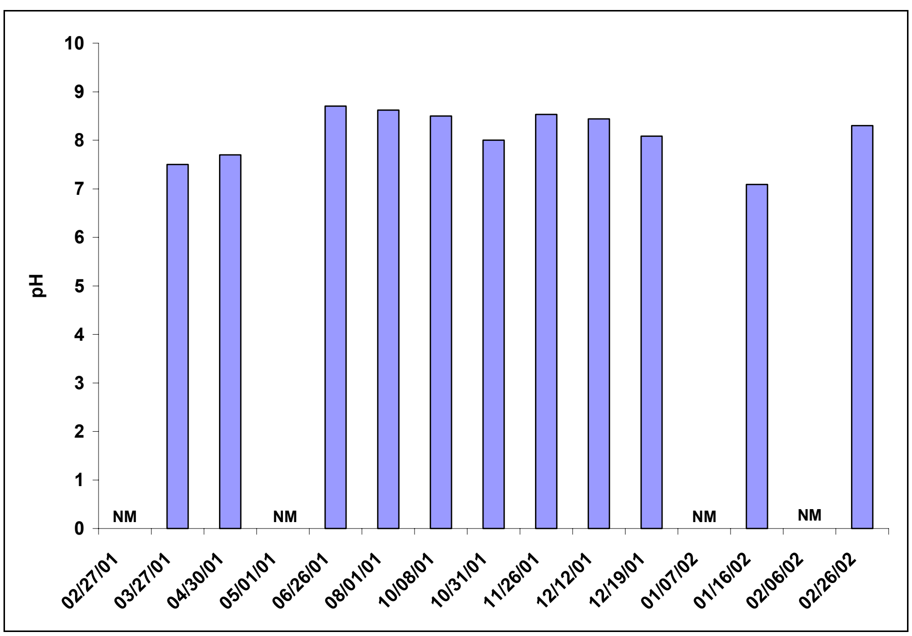

Figure 37. pH Monitoring Results for Butcher Creek

Nutrients

Nuisance aquatic growth can adversely impact aquatic life and recreation. Algae of various types grow in the water and on the beds of streams. Algae provide a food source for many aquatic insects, which in turn serve as food for fish. Algae grow where the substrate is suitable and sufficient nutrients (nitrogen and phosphorus) are available to support growth. Flow, temperature, and sunlight penetration into the water all must combine with nutrient availability to produce conditions suitable for photosynthetic growth. When nutrients exceed the quantities needed to support primary productivity, algae blooms may develop. Subsequent death and decay of algae creates an oxygen demand. If the demand is high enough due to large algae blooms, DO concentrations in the water body may decline to low levels that harm fish. Algae blooms and excessive rooted macrophytes can also physically interfere with recreational activities such as swimming and wading and directly alter fish habitat. In addition, decomposing algae can create objectionable odors, and some species produce toxins that impair the agricultural water supply.

Nutrient limitations occur when a nutrient, usually phosphorus or nitrogen, is below the level needed for algal growth in the water column. Influxes of these nutrients will stimulate algal growth if other factors, such as light, temperature, and flow, are conducive to growth. Alternatively, a system can have high enough levels of nutrients that growth is limited by other factors besides nutrients, and nutrient levels must be decreased to limiting levels to have an effect on algal biomass.

Idaho's narrative standard for nutrients states: "surface waters shall be free from excess nutrients that can cause visible slime growth or other aquatic growths impairing beneficial uses" (IDAPA 58.01.02.200.06). Salmonid spawning beneficial uses can be impaired when excess algae decompose, resulting in depleted dissolved oxygen levels. Primary/secondary contact recreation can be also impacted by visible slime and algae growth caused by excessive nutrients when temperature and sunlight are not limiting. Salmonid spawning can be impaired when excess algae decompose, resulting in depleted DO levels.

Phosphorus Compounds

Total phosphorus (TP) consists of both particulate and dissolved fractions of both organic and inorganic phosphorus compounds. Dissolved phosphorus consists of all forms of phosphorus in solution, whether organic or inorganic. Phosphorus in solution in surface waters occurs almost solely as phosphates. Orthophosphate ($PO4^{-3}$) is the form that plants can use, and thus best correlates to short-term stimulation of growth.

In order to prevent nuisance algae growth and dissolved oxygen problems, USEPA (1986) developed a national guideline for streams of 0.1 mg/L TP. More recently USEPA (2000) developed a nutrient criteria for total phosphorus of 0.030 mg/L TP specific to Columbia Plateau subecoregion streams. These criteria provide USEPA's most recent recommendations to states and authorized tribes for use in establishing their water quality standards. USEPA further recommends that, wherever possible, states develop nutrient criteria that fully reflect localized conditions and protect specific designated uses.

Total phosphorus in Threemile Creek ranged from 0.06 mg/L (headwaters) to 4.55 (WWTP outfall). Ortho-phosphorus concentrations ranged from 0.04 mg/L above the WWTP outfall to 3.72 mg/L at the outfall, with an overall average of 0.93 mg/L (Table 24). The WWTP outfall had the largest range in values, while the mouth had the lowest range. The ratio of ortho-phosphorus to total P ranged from 0 to 1 and averaged 0.47 (above outfall), 0.82 (outfall), 0.85 (below outfall), and 0.72 (mouth).

Table 24. Ortho-phosphorus concentrations on Threemile Creek (February 22, 2000, to February 6, 2001).

	Above Outfall	Outfall	Below Outfall	Mouth
Mean (mg/L)	0.05	1.79	1.03	0.22
Maximum (mg/L)	0.09	3.72	2.87	0.31
Minimum (mg/L)	0.02	0.15	0.30	0

Concentrations of P in ground water ranged from 0.01 to 0.28mg/L on the Camas Prairie with a median of 0.05 mg/L (Crockett 1995). A well sampled in the Threemile Creek watershed had average P levels of 0.03 mg/L (Hagen 2002).

Grangeville's WWTP contributes 43% of the flow to the creek and a concentration of 1.79 mg/L P on an annual average with peak concentrations in the spring and summer. At the WWTP outfall monitoring point, the concentration of ortho-phosphorus is high in the late winter and summer and low in spring and late fall/early winter (Figure 37). The facility controls concentrations of P entering the creek using holding tanks, which settle out solids containing P. High P levels from the WWTP in the late winter and early spring may be a result of sediment entering the city's sewage system through leaks in pipes during times of high precipitation. The city of Grangeville has recently begun a program of maintaining the sewer pipes to reduce inflow.

There is no seasonal change in ortho-phosphorus above the outfall or at the mouth of Threemile Creek (Figure 38). Above the outfall, P concentrations in the creek may be influenced by storm water runoff from Grangeville, the natural background levels in soils, geological sources, and land management activities such as livestock grazing. The mouth of Threemile Creek has a fairly constant concentration of P.

Total phosphorus in Butcher Creek ranged from 0.1 to 0.49 mg/L, and averaged 0.16 mg/L. There were three exceedances of USEPA recommended levels for TP during the 15 months monitored (0.49 mg/L, 0.23 mg/L, and 0.24 mg/L). Ortho-phosphorus, the form of P most readily available for plant uptake, ranged from 0.054 mg/L to 0.109 mg/L, and averaged 0.094 mg/L (Figure 39). Five samples exceeded 0.1 mg/L ortho-phosphorus at the mouth of Butcher Creek.

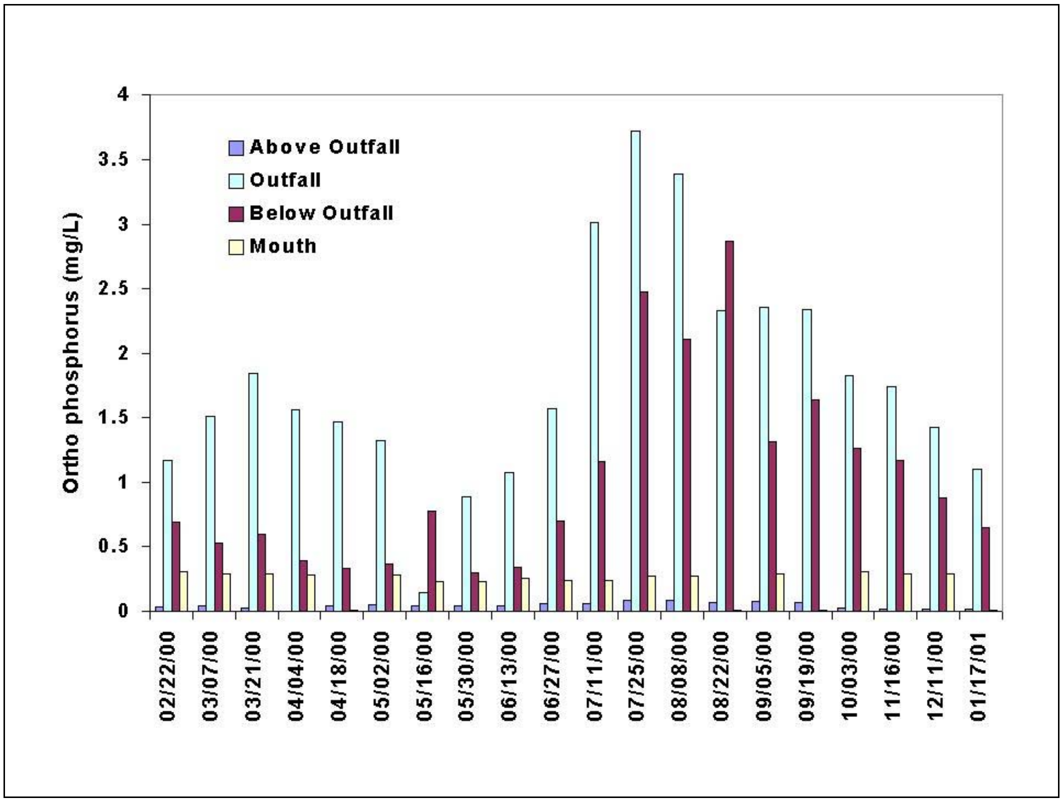

Figure 38. Ortho-phosphorus Monitoring Results for Threemile Creek

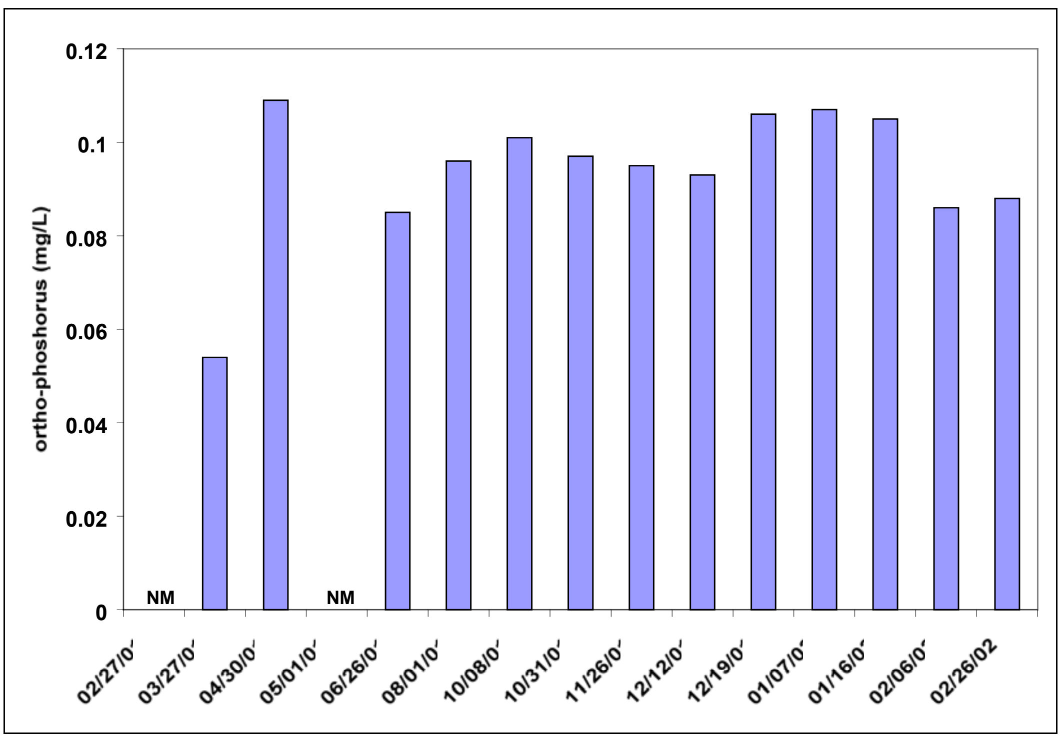

Figure 39. Ortho-Phosphorus Monitoring Results for Butcher Creek

Nitrogen Compounds

In surface waters, nitrogen (N) occurs as nitrate (NO_3), nitrite (NO_2), ammonia, and organic N. Nitrate-nitrite covers most of the nitrogen available in surface waters. Ammonia is also available for plant uptake. Total Kjeldahl nitrogen (TKN) is the fraction of organic N bound in the aquatic organisms and unavailable for plant growth. Upon decomposition, organic N can be converted to inorganic N and become available for plant uptake. Total nitrogen (TN) is composed of inorganic and organic nitrogen.

In order to prevent nuisance algae growth, USEPA (1993) developed a national guideline for streams of 0.3 mg/L TN. More recently, USEPA (2000) developed a recommended nutrient criterion of 0.22 – 0.36 mg/L TN specific to the Columbia Plateau subecoregion streams.

A ground water well monitored by the Idaho Department of Water Resources (IDWR) within the Threemile Creek watershed contained very low levels of NO_3. Nitrate concentrations were less than 0.05 mg/L in seven out of eight years, with a maximum concentration of 0.074 in 1996 (Hagen 2002).

Threemile Creek average annual TN levels exceeded 0.30 mg/L at each monitoring point along Threemile Creek, except at the headwaters. The TN concentrations ranged from 0.16 mg/L above the outfall to 24.95 mg/L at the outfall, with an overall average of 7.14 mg/L (Table 25). The largest range in values was seen below the outfall and the lowest range was above the outfall. The ratio of inorganic N to TN ranged from 0-1 and averaged 0.25 (above outfall), 0.91 (at outfall), 0.88 (below outfall), and 0.86 (mouth).

Table 25. Total nitrogen data summaries for Threemile Creek (February 22, 2000 to February 6, 2001).

	Above Outfall	Outfall	Below Outfall	Mouth
Mean (mg/L)	0.35	17.4	8.72	2.31
Maximum (mg/L)	1.16	24.95	22.22	8.33
Minimum (mg/L)	0.16	12.37	2.47	0.23

Concentrations of TN above the WWTP outfall after the creek has passed through some grazing land, farmland, and the city of Grangeville averaged 0.35 mg/L and had a maximum of 1.16 mg/L. However, the summer month values were lower than 0.30 mg/L.

At the outfall monitoring point, the concentration of TN is highest in the late winter and summer and lowest in the spring and late fall/early winter (Figure 40). The WWTP outfall appears to influence levels downstream. Although there is no seasonal change in TN above the outfall, at the mouth TN concentrations are greater in the winter and spring than in the summer and early fall.

Sources of N in the watershed include the WWTP, livestock management, and agricultural practices, including fertilizer application.

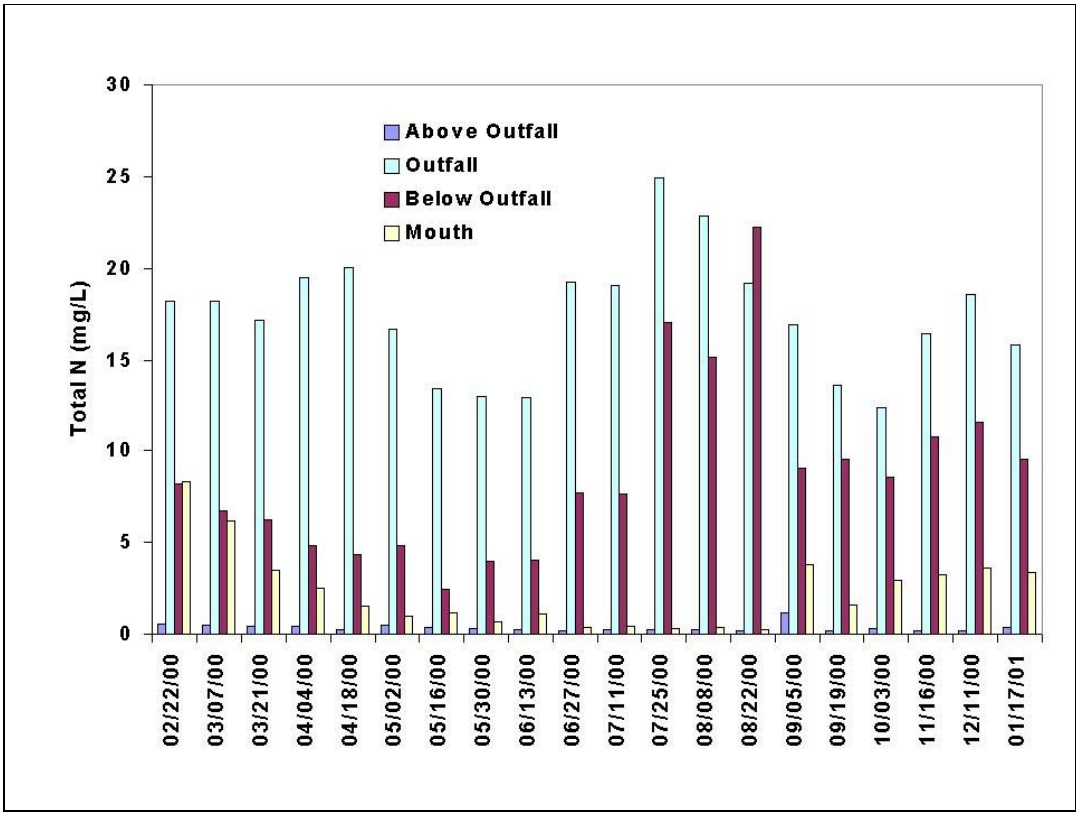

Figure 40. Total Nitrogen Monitoring Results for Threemile Creek

The TN concentrations in Butcher Creek averaged 1.24 mg/L (Figure 41). The highest levels occurred in January, February, and March and correlated with high stream flows. The TN levels exceeded 0.30 mg/L for 11 out of 14 samples. However, during the summer growing season, values were near or just above this target (0.33 mg/L on June 26 and August 1, 2001).

The concentrations of TN at the mouth of Butcher Creek show a high degree of seasonality and relationship with flow: highest levels in the spring, then decreasing in the summer. Due to the N levels approaching 0.3 mg/L during the summer growing season/critical time period, and no violations of the DO criteria, it is concluded that beneficial uses are currently being met. Although no TMDL is established for N at this time, consistently high fall and winter values (ranging from 0.5 to 5.01 mg/L) warrant further observation. Best management practices that reduce temperature and sediment pollution in the watershed (i.e., vegetative buffers, fences, livestock exclosures, and grazing management) should also effectively reduce levels of N. Follow-up implementation effectiveness monitoring is recommended to ensure an overall reduction in N loading.

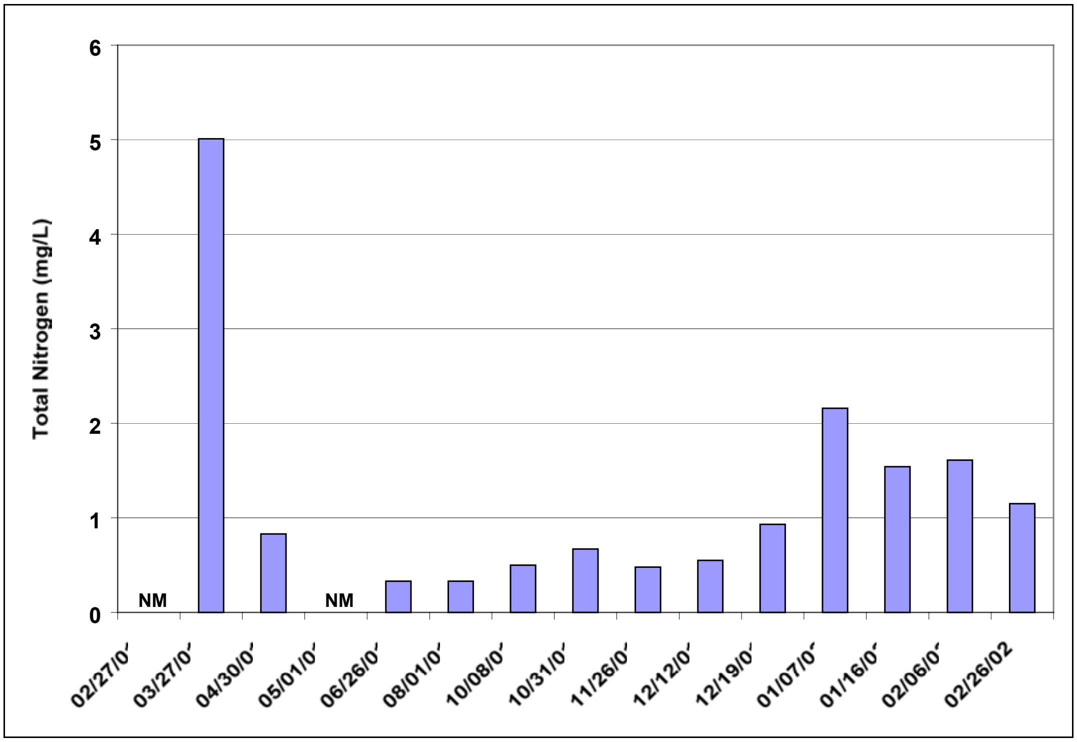

Figure 41. Total Nitrogen Monitoring Results for Butcher Creek

Other Water Quality Studies

An Idaho Division of Environmental Quality report (DEQ 1979) summarized a study conducted on Threemile Creek in 1976 and 1977. The purpose was to assess the effect of Grangeville's WWTP on the stream and develop effluent limitations for the discharge as required for an NPDES permit. A secondary purpose was to determine if Threemile Creek met requirements for Class A waters. Five sampling stations were selected and monitored during high and low flow periods. Field and laboratory analyses were carried out for each site and date. Bacteria levels were well above the standard and both P and N levels were found in high concentrations (Table 26).

Table 26. Total phosphorus, nitrate-nitrogen, and bacteria for all stations and dates along Threemile Creek.

	Total P (mg/L)[a]	NO_3-N (mg/L)[b]	*E. coli* (cfu/100 mL)[c]
Above Grangeville			
November 17, 1976	0.18	0.01	200
November 18, 1976	0.15	0.02	200
June 7, 1977	0.14	0.03	900
June 8, 1977	0.17	0.01	740
Above Outfall			
November 17, 1976	0.13	0.10	200
November 18, 1976	0.20	0.01	400
June 7, 1977	0.19	0.02	680
June 8, 1977	0.25	0.11	4500
100 feet Below Outfall			
November 17, 1976	6.55	11.41	200
November 18, 1976	5.44	10.20	200
June 7, 1977	3.55	4.33	855
June 8, 1977	2.44	4.52	5400
1.25 miles Below Outfall			
November 17, 1976	5.75	12.60	200
November 18, 1976	6.55	9.56	200
June 7, 1977	2.24	4.55	3100
June 8, 1977	2.98	4.64	780
3 miles Below Outfall			
November 17, 1976	3.54	8.85	200
November 18, 1976	5.51	10.25	200
June 7, 1977	1.84	1.62	380
June 8, 1977	2.55	4.52	520

[a] Total phosphorus in milligrams per liter
[b] Nitrate-nitrogen in milligrams per liter
[c] Colony forming units per 100 milliliters

The study concluded that the WWTP contributed to the pollution of the creek through additions of nutrients, and that the bacterial problem was caused by nonpoint source pollution from livestock and poor private septic facilities upstream of the WWTP. The recommendations at the time were to upgrade the WWTP to reduce nutrients and revise the chlorinating procedure to maintain acceptable bacteria levels. Best management practices for the nonpoint sources were identified for agricultural runoff, summer livestock grazing, and winter livestock holding areas.

On the Clearwater Plateau continued sampling for nutrients and pesticides by IDWR and the Idaho Department of Agriculture (IDA) have documented significant zones of ground water contamination exceeding the 10 mg/L drinking water standard for NO_3-N, with a maximum 80 mg/L NO_3-N measured in the sampling. This contamination appears to be located in geologic environments where granitic outcrops exist as islands surrounded by basalt.

In April 1995, IDWR produced a Water Information Bulletin (Crockett 1995) that summarized the results of a ground water monitoring program carried out from 1991 through 1993. One of the objectives of the study was to determine the background levels in ground water in the aquifers of Idaho. The results indicate that the Clearwater aquifer contains elevated background levels of TP and NO_3 (Table 27).

Table 27. Range and median of nutrients in the Clearwater aquifer measured from 1991 through 1993 (Crockett 1995).

	Nitrate (mg/L)[a]	Ammonia (mg/L)	Phosphorus (mg/L)
Range	0.05 – 19.00	0.01 – 0.29	0.01 – 0.28
Median	0.38	0.01	0.05

[a] milligrams per liter

In 1998 DEQ produced a report on the reconnaissance of NO_2 and NO_3 in the Camas Prairie ground water. Although the report indicates elevated levels of NO_3 on the prairie, the single well within the Threemile Creek watershed contained very low levels of NO_3. Nitrate concentrations were less than 0.05 mg/L in seven of eight years (maximum was 0.074 mg/L in 1996), while concentrations of P averaged 0.03 mg/L (Hagen 2002).

Threemile Creek Conclusions

Flow was below normal and air temperatures were higher than normal during the summer months that Threemile Creek was monitored. The low flow and high temperatures could indicate a year where there may have been less recreational use and higher than normal concentrations of pollutants in the creek.

Pathogen levels in the creek are above the secondary contact criteria set by the state. Potential sources include grazing/livestock operations, septic systems, and waterfowl and animals.

Dissolved oxygen levels were borderline at the mouth on two occasions and no data were available to evaluate diurnal DO sags. Further monitoring to verify DO levels at critical times is warranted

In-stream ammonia concentrations were below the criteria set by the state of Idaho. The Grangeville WWTP discharges ammonia and is well within its permit limit. Since ammonia levels are below criteria, a TMDL will not be written. It is recommended that Threemile Creek be delisted for ammonia.

The nutrient levels in Threemile Creek are generally an order of magnitude or more higher than the USEPA "Goldbook" guidelines (USEPA 1986). Nitrogen levels above the WWTP outfall are lower than the 0.3 mg/L guideline. At the WWTP outfall and below it, the TN concentrations are much higher and are a cause for concern. At the mouth of the creek the level of TN tends to be seasonal, decreasing in the summer when the concentration at the outfall reaches its maximum. This may indicate that plants are taking up the TN. Phosphorus concentrations are at or below the USEPA guidelines above the WWTP outfall, but are higher than the guidelines at and below the outfall. The TP concentrations at and below the outfall also increase in the spring and summer. The WWTP outfall directly influences the site below it. There are no indications that the concentration of TP has any seasonality at the mouth; the concentration of TP remains at a steady 0.30 mg/L regardless of flow, temperature, or any other parameter measured during this monitoring period.

Due to the significantly elevated levels of TN and TP, these nutrients were considered for the development of TMDLs. The deleterious effects of high and/or unbalanced nutrient levels, i.e., nuisance algal growth and/or low DO, can be controlled if nutrient levels are returned to levels that limit algal growth.

Butcher Creek Conclusions

There were no instantaneous exceedances of either primary or secondary contact recreation *E. coli* criteria during the 15-month sampling period, although on two occasions levels exceeded 126 cfu. Since *E. coli* concentrations were below criteria on all sampling dates, a TMDL will not be written. It is recommended that Butcher Creek be delisted for bacteria.

Dissolved oxygen levels were never low enough to cause a concern and may indicate the lack of excessive algae growth in the creek at the monitoring site. Since the DO concentrations were above the criteria on all the sampling dates, a TMDL will not be written. It is recommended that Butcher Creek be delisted for DO.

The nitrogen levels in Butcher Creek are generally higher than the USEPA guidelines, and generally occur in winter during periods of high flow. Phosphorus levels were generally within the guidelines set by USEPA. Nitrogen levels are elevated, but there is no indication that there is a DO or nuisance algae problem. A TMDL for nutrients will not be written; however, the implementation of the TMDLs being written for temperature and sediment is expected to lower the N levels.

Summary and Analysis of Existing Water Quality Data for Lucas Lake

Lucas Lake is a small, locally named water body that is 303(d) listed for sediment. Based on a DEQ report by Steed (2002), Appendix P, Lucas Lake supports beneficial uses of primary contact recreation and cold water aquatic life.

Lucas Lake was originally listed in 1994, based on earlier BLM reports that indicated possible problems with sediment. Since the lake lies in a placer mining zone, DEQ monitoring included a screening for toxic substances (metals). DEQ sampled the lake in December 2001 and again in June 2002. The results from the sampling are shown in Appendix N.

The TSS concentrations from both sampling periods are below the 4 mg/L detection limit. Although turbidity is not reported, it is unlikely that 4 mg/L could correlate to anything close to the WQS of 50 NTU above background. (A handwritten note of the lab sheet indicates an NTU reading of 0.80 NTU.)

The metal screening did not indicate any problems with toxic metals.

It is recommended that Lucas Lake be removed from the 303(d) list for sediment.

2.4 Data Gaps

Data gaps identified in this section provide readers with an idea of the amount of error involved in the analyses, and set the stage for research and data development necessary to improve the quality of these analyses.

Flow

In order to do flow-based analyses for sediment TMDLs, it would be helpful to have actual flow measurements, rather than extrapolating from existing data sets. While the level of error introduced by extrapolated flow is probably less that the error in the sediment yield curves, better flow data is important to understanding water quality.

We did not have continuous flow data for the points above and below the WWTP at Grangeville, and virtually no flow data for any of the other point sources. The effects of point sources for nutrients, temperature, and sediment are all dependent on some kind of flow estimation that corresponds to water quality data of the effluent.

Water Column Data

Diurnal DO monitoring is needed to determine the effects of the Grangeville WWTP on DO levels in Threemile Creek.

Intergravel DO data would be helpful in determining if the criteria are being met for salmonid spawning in Threemile Creek and Butcher Creek.

Increased frequency of sampling for *E. coli* to more accurately determine criteria exceedances and genetic fingerprinting to determine the source of pathogens would be helpful in Threemile Creek and Butcher Creek.

An analysis of streambed and bank sediments is recommended to determine exchange coefficients for phosphorus in order to evaluate effects of phosphorus in the system.

There are no good data sets for background turbidity and TSS to relate to the state WQS. Our estimates of background are based on the sediment budget and; therefore, incorporate the huge errors involved in translating sediment source data to in-stream sediment results.

Similarly, more extensive turbidity and TSS data throughout at least the lower part of the basin, over several years, would improve the reliability of our sediment loading analyses. For the most part, the data set we have applied to the loading analysis would be considered below the minimum necessary by most professionals.

We attempted to collect and model bedload data, realizing that some sort of quantification would be necessary to write the TMDLs. We were only able to collect a minimal amount of bedload data for the Stites and Harpster sites, yet the impairment we are trying to address throughout the subbasin above Harpster is bedload. Bedload data for all of the 303(d) listed water bodies would have been helpful. We failed in our modeling effort because we were unable to collect enough data to get the model to work reliably.

More systematic monitoring on an annual basis of the effects of suction dredging on water column and substrate sediment levels would allow better quantification of sediment loading impacts from this industry.

Temperature

Continuously recorded stream temperature data exist for a large number of sites in the SF CWR Subbasin. Many of these sites are at the mouths of streams—the warmest locations. A few streams have several temperature recording sites such that the beginning of a linear temperature profile can be developed. However, for the most part, we lack information about stream temperatures along the full lengths of any stream. We have neither recorded data for temperature profiles, nor stream parameter and heat loading data to be able to model the profiles. We assume that the stream temperature data from one or a few sites within a given water body represent the temperature profile for the whole water body.

The narrative part of the Idaho WQS identifies temperature (heat) pollution to be controlled and regulated as that part of heat loading which has resulted from human activity, as opposed to the level of heat loading or stream temperature that existed prior to human intervention. We do not have data or models that quantify the level of heat loading or stream temperatures prior to human intervention.

Biological and Other

We have no baseline data for the condition of fish populations and their spawning habitat, or other physical/hydrologic data prior to human intervention in the subbasin. We attempt to overcome this deficiency with data from reference sites, modeling, and professional judgement.

We acquired stream habitat data sets from reference watersheds and compared them to streams in the SF CWR Subbasin. Cobble embeddedness is the primary parameter for which we could quantify the differences, but we were unable to determine the relationship between percent cobble embeddedness and sediment loading. Much better reference data would be useful to be able to fully assess the impact of human activity in any particular water body.

Currently data is lacking in order to quantify the effects of agricultural chemicals on stream biota and their accumulation in fish tissue. A study conducted by USEPA and the Columbia River Inter-tribal Fish Commission in 1996-97 detected 92 chemicals in fish tissues collected in the Columbia Basin, including the Clearwater River (USEPA 2002). The concentrations of pesticides were higher in the resident species, especially mountain whitefish, white sturgeon, largescale sucker, and whole body walleye than in anadromous species. Of the anadromous fish species, Pacific lamprey had higher levels of polychlorinated biphenyls (PCBs). This appears to be associated with the high amount of fat in these fish types since PCBs and pesticides are readily absorbed by fats. The NPT will begin assessing fish tissue for heavy metals and volatile organic compounds (including pesticides) as part of their Environmental Monitoring Assessment Program (EMAP) in 2003. Studies of the effects of agricultural chemicals on stream macroinvertebrates (insects) have not been done.

Beneficial Uses

Beneficial use support status assessment for the main stem SF CWR is not available at this time. The assumption was made that the main stem is not fully supporting its beneficial uses, but data are largely nonexistent to support this assumption.

While there is ample information in the literature relating sediment and/or temperature to fish spawning and reproductive health, there is little site-specific data linking sediment and/or temperature in the SF CWR Subbasin to its beneficial uses.